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WITH

International Abstract of Surgery

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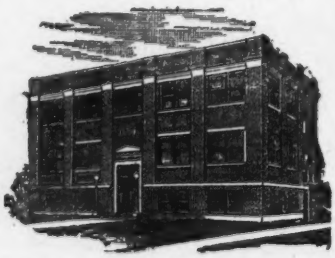

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SURGERY, GYNECOLOGY AND OBSTETRICS

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THE RADICAL CURE OF PELVIC DEFORMITY

BY HENRY JELLETT, M.D., F.R.C.P.I., DUBLIN
Master, Rotunda Hospital

I THINK it is time that some attempt should be made to remove a discredit that rests on obstetricians, inasmuch as, while successful attempts have been made to cure almost every other form of bone deformity by surgical intervention, the very serious deformity of contracted pelvis has been left practically unconsidered and uncured. It cannot be said in excuse that it is a condition which does not require cure, because, both for the sake of the patient, her unborn children, and the annual birth rate, cure, if possible, is advisable. Further, it cannot be said that no surgical cure is available, because for certain cases at all events it has been in our hands for years. If an excuse cannot be found, a reason, or rather several reasons can, and they are shortly these. Obstetricians have been divided into two camps in regard to cutting operations on the pelvic bones; a minority regard such operations not merely as justifiable but as advisable. A large majority regard them as neither the one nor the other. Further, those who believe have their belief narrowed and limited because they have been brought up to regard such operations solely as a means of terminating a particular labor, and have altogether, or almost altogether, passed by the larger view that they can be used as a means of effecting a permanent cure. I think the time has now come both for a little plain speaking on this important subject, and for a complete revision of our views. Plain speaking is necessary to those who would cut out of obstetrical surgery such operations. A revision of views is necessary for those of us who have recognized that the operations have their place therein, but have not recognized quite what that place might be. I ask in advance for pardon for two things: First, if I am rather dogmatic in this matter. I should not be so, if the evidence in favor of my views were not so overwhelming, and if the opposition to them was not likely to be so strong. Second, if I am unwittingly regarding myself as the introducer of views, which have already been brought forward by others. Necessity is my excuse for the one fault. Ignorance is my excuse for the other, if it exists.

The different cutting operations on the pelvic bones with the object of causing enlargement of the intrapelvic diameters may be reduced, for practical purposes, to one, namely, pubiotomy. The nature of this operation, and its advantages over others of a similar kind, are so well known as not to require description. The general views regarding it held by those who sanction its use, may be briefly stated as follows: It is a method of treatment to enable a particular labor to be successfully terminated. It is suitable for the second degree of pelvic contraction, i.e., that degree in which the conjugate diameter measures between 8

centimeters and 7 centimeters in the case of a flat pelvis or between 8.5 centimeters and 7.5 centimeters in the case of a generally contracted pelvis. Pelves which measure above these lengths are considered to be amenable to other lines of treatment. Pelves which measure below these lengths are considered to be too small. It is an alternative to cæsarean section. It is to be carried out at the end of the second stage of labor, when the natural efforts fail to effect delivery, and either with or without a preliminary attempt to deliver with the forceps. It is desirable that bony union of the cut surfaces should result.

I wish in this paper to disprove every one of these points, and perhaps it will facilitate my argument if I begin by saying, what it is I want to prove. It is shortly as follows: First, that pubiotomy is not merely a method of terminating a difficult labor, it is rather a means of effecting a radical cure of pelvic contraction. Second, that it is indicated in both the first and second degrees of contracted pelvis. Third, that it is not an alternative to cæsarean section any more than the wiring of a fractured bone is an alternative to amputation of the limb. Fourth that it should never be postponed willingly to the end of the second stage, but should ideally be carried out independently of pregnancy when its effects are likely to be required. Fifth, that every effort should be made to avoid bony union of the cut surfaces.

Before coming to the discussion of these points, however, I must first demonstrate, to those who oppose the operation, that it is a safe and advantageous one.

The safety of pubiotomy can best be proved by the statistics of thirty-five operations, to be found summarized in Table I, which operations were performed by my predecessors at the Rotunda Hospital or by myself. Of these thirty-five women, two died. The first patient died of heart failure immediately after delivery, due, as proved by a postmortem examination, to fatty degeneration of the heart. The second patient died some weeks after delivery, of acute miliary tuberculosis, as proved by postmortem examination. Five children out of 36 were born dead. One of these was the second of twins, the first child being alive, and another was hydrocephalic. In two cases injury to the bladder wall resulted. In one, immediate cure followed the suture of the tear. In the second the fistula was not detected at the time of operation, and so was not sutured. It occurred in the patient who subsequently died of acute miliary tuberculosis. Every patient, except the two who died, left the hospital in perfect health and with no impairment of the power of walking.

The advantages of pubiotomy can be best proved by two parallel cases on both of which I operated myself, in the one case performing pubiotomy, and in the other cæsarean section. These cases are as follows:

Mrs. E. B. Flat pelvis measuring 7 centimeters in the conjugate and 10.8 centimeters in the transverse. Delivered by cæsarean section, March 14, 1911. She had four subsequent cæsarean sections, the last being performed on November 22, 1918, when I also tied her tubes and did a plastic operation to restore her abdominal wall.

Mrs. C. O'C. (Case No. 13) generally contracted pelvis measuring 7.3 centimeters in the conjugate, and 9.35 centimeters in the transverse. Pubiotomy was performed on August 22, 1912, a living child of 7 pounds 4 ounces being born. She had four subsequent confinements, of which three were spontaneous deliveries, the children weighing 8 pounds, 8 pounds, and 8 pounds and 6 ounces, respectively, while one child was delivered also alive by the forceps, applied for no apparent reason, after she had been a few hours in labor. The last child was born on January 1, 1919, and her pelvis at that time measured 8.95 centimeters in the conjugate, and 11.85 centimeters in the transverse. The measurements both in 1912 and in 1919, were made by myself, and I have no reason to think that any material error occurs in them. The incision in the pubic bone had joined by fibrous union, and the bones were mobile.

The deductions from these two cases are so obvious that I need not spend time in discussing them, and so I may pass on to the different points which I propose to try to establish.

1. *Pubiotomy is not merely a method of terminating a difficult labor, it is rather a means of effecting a radical cure of pelvic contraction.* To prove this it is only necessary to refer to Tables II and IV at the end of this paper. It will be seen from them that whereas in forty-five labors previous to pubiotomy,

six children were delivered alive spontaneously and four delivered alive by the forceps, in twenty-two labors occurring subsequent to the labor at which pubiotomy was performed, eleven children were delivered alive spontaneously, six delivered alive by the forceps, and two by a second pubiotomy. Further, that the death of one of the three children born dead was due to placenta prævia, and so must not be counted. These figures are very striking in view of the fact that women who have difficult confinements after pubiotomy naturally tend to return to the hospital and so are included in the statistics, while women who have no trouble are perhaps usually content to remain at home and so escape observaton. Moreover, in practically all these cases every effort has been made to promote bony union of the pubic incision, and, whenever it occurred, the full benefit of the operation has not been obtained.

2. *Pubiotomy is indicated in both the first and second degrees of contracted pelvis.* Up to the present, the teaching of those who accept pubiotomy has been that the operation is indicated in the second degree only. In the first degree, it is usual either to allow the head to mold through the pelvic canal, or to perform prophylactic version. The molding of the head through the pelvis in a case of contraction is, as every one knows, a tedious process, and a most painful one for the patient. It frequently results in the labor ending with the application of the forceps when perhaps the head is still above the pelvic brim, and even in failure to deliver by this means. It is then too late to adopt measures other than perforation, and indeed in most cases the death of the child has already occurred. Similar difficulties and dangers to both mother and child recur at each subsequent labor, and tend to increase in degree after the third or fourth in consequence of the increasing size of the child. Once we abandon the idea that pubiotomy is a means of ending a particular labor, and regard it as a means of curing contracted pelvis, its adoption in the first degree is even more strongly indicated than in the second, because while occasionally it may fail in the lower limits of the latter degree to cause sufficient permanent increase in size in the pelvis, in the first degree it will probably always be successful.

It may be asked how one is to distinguish between the upper limits of the first degree of contraction and a normal pelvis. The answer will be furnished by the histories of the patients concerned. If a woman whose measurements are below normal has difficult and dangerous labors obviously due to pelvic contraction, pubiotomy is indicated in order to produce safe and easy labors.

3. *Pubiotomy is not an alternative to cæsarean section any more than is the wiring of a fractured bone an alternative to amputation of the limb.* Of necessity any observations on this point are in the nature of a repetition. Once it is admitted that pubiotomy is safe, and that it produces permanent cure, then it takes its place accordingly, while cæsarean section, on the other hand, is only a means of effecting the termination of a particular labor. It has its uses; for example, in an elderly patient who is not likely to become pregnant again, it is a more certain method of ensuring the birth of a living child, since the ordinary dangers of labor are avoided. If it was a suitable operation to perform late in the second stage, I should advise its adoption in primiparæ who came under treatment too late for an early pubiotomy, because I believe almost all the risks associated with the latter operation are due to its late performance. Unfortunately, however, cæsarean section is equally, or even more unsuited for such cases, on account of the risk of an existing infection of the uterus.

4. *Pubiotomy should never be postponed willingly to the end of the second stage, but should ideally be carried out independently of pregnancy when its effects are likely to be required.* So far as my experience goes the two principal causes of injury during or after pubiotomy are, first, the penetration of the bladder by the pubiotomy needle, and, second, the combined association of the presence of blood beneath the vaginal mucous membrane and a gap in the bony support at the site of incision. Penetration by the needle does not concern us at the moment, while the

TABLE I.—STATISTICS OF 35 PUBIOTOMY OPERATIONS

No.	Name	No. of Labor	Nature of Previous Labors	Pelvic Measure		Date of Operation	Operator	Result		Wt. of Child Lbs.	Nature of Subsequent Labors
				C. V. cms.	T. cms.			Mother	Child		
1	C. S.	V	I Breech; dead II Breech; dead III Miscarriage IV Breech; alive but died	7.5	12	March, 1907	Dr. Tweedy	A	D	6¼	VI Spontaneous; alive; 8½ pounds; April, 1909. VII Spontaneous; alive; 7¾ pounds; May, 1910. X Spontaneous; impacted breech; alive; very large; March, 1914.
2	B. G.	IV	All difficult; dead; forceps; version; etc.	8	11.5	May, 1907	Dr. Tweedy	A	A	8⅜	
3	E. B.	I		7 On return 8.5	10.5 10.5	May, 1907	Dr. Tweedy	A	A	7¾	II Spontaneous; alive; 7½ pounds; May, 1908.
4	S. F.	IV	I Forceps; dead II Induction, 33rd. week; child alive; 3 pounds III Induction, 36th week; version; dead; 5¾ pounds	7	11.5	June, 1907	Dr. Tweedy	A	A	10	
5	M. D.	III	I Symphysiotomy; dead; July, 1907 II Abortion	8	12.8	Sept., 1910	Dr. Tweedy	A	A	6¾	
6	R. N.	I		8.5	12.4	Nov., 1909	Dr. Tweedy	A	A	8	II Spontaneous; alive; 8½ pounds; July, 1912.
7	M. O'T.	IV	I Forceps; dead II Forceps; dead III Forceps; dead	7		Oct., 1910	Dr. Tweedy	A	A	7⅜	V Transverse; podalic version; dead; 6¼ pounds; Jan., 1913. VI Forceps; alive. VII Forceps; dead. VIII Breech; alive. IX Pubiotomy; alive (vide No. 32).
8	M. C.	III	I Craniotomy II Craniotomy	8.3	13	Nov., 1910	Dr. Tweedy	A	A	7	IV Spontaneous; breech; alive; 8½ pounds; March, 1914.
9	M. K.	II				Nov., 1910	Dr. Jellett	A	A	6¾	
10	M. B.	IV	I Forceps; alive II Spontaneous; alive III Spontaneous; alive	7.2	12.4	March, 1911	Dr. Jellett	A	A	6¾	V Forceps; alive; June, 1912.
11	K. B.	I		7	12.5	March, 1912	Dr. Jellett	A	A	6¾	II Placenta prævia; hydramnios; internal version; dead; 6¼ pounds; March, 1913.
12	M. W.	II				June, 1912	Dr. Jellett	A	A*		
13	C.O'C.	I		7.3	9.3	Aug., 1912	Dr. Jellett	A	A	7¼	II Spontaneous; alive. III Spontaneous; alive. IV Forceps; alive. V Spontaneous; alive.
14	M. R.	III		8.5	....	April, 1913	Dr. Jellett	A	A	8⅜	
15	R. M.	II	I Spontaneous; premature; alive	9.4	....	April, 1913	Dr. Jellett	A	A	8¼	
16	R. S.	IV	I Forceps; alive II Brow; version; lived a few minutes III Brow; forceps; lived 1 hour	9.1	11	Aug., 1913	Dr. Jellett	A	A	9½	
17	M. G.	IV	I Forceps; alive II Forceps; dead III Forceps; dead			Nov., 1913	Dr. Jellett	A	A	10½	V Pubiotomy; alive; 9⅝ pounds; Feb., 1916 (vide No. 23). VI Forceps, due to uterine inertia; alive; 8½ pounds; Jan., 1919.
18	M. C.	V	I Forceps; lived a day II Forceps; lived a few minutes III Craniotomy IV Craniotomy	8	11.25	April, 1914	Dr. Jellett	A	A	10	
19	A. R.	I		8	9.3	Aug., 1914	Dr. Jellett	D	A	6¼	

TABLE I.—continued

No.	Name	No. of Labor	Nature of Previous Labors	Pelvic Measure		Date of Operation	Operator	Result		Wt. of Child Lbs.	Nature of Subsequent Labors
				C. V. cms.	T cms.			Mother	Child		
20	F. M.	I		8	9	July, 1915	Dr. Tweedy	A	A D	5¼ 4⅜	II Spontaneous; alive.
21	K. C.	X	I Twins; dead II Forceps; dead III Premature; 7 mo. IV Spontaneous; alive V Forceps; dead VI Abortion VII Spontaneous; alive			Sept., 1915	Sir. Wm. Smyly	A	A	5½	
22	E. D.	VII	Not recorded			Dec., 1915	Sir. Wm. Smyly	A	D	9¼	
23	M. G.	V	I Forceps; alive II Forceps; dead III Forceps, dead IV Pubiotomy; alive (vide No. 17)	9.5	10.25	Feb., 1916	Dr. Purefoy	A	A	9⅝	VI Forceps, due to uterine inertia; alive; 8½ pounds; Jan., 1919.
24	J. J.	I		8.75	....	June, 1917	Dr. Tweedy	A	A	6⅕	II Forceps; alive.
25	M. K.	I		9	....	July, 1917	Dr. Purefoy	A	*D	7½	
26	L. B.	I		8.8	11	Jan., 1918	Dr. Jellett	A	A	6⅜	
27	M. K.	I		8.2	....	April, 1918	Dr. Jellett	A	A	7½	
28	M. O.	II	I Abortion	8.5	....	April, 1918	Dr. Jellett	A	A	6⅞	
29	L. D.	I		8	12.3	June, 1918	Dr. Jellett	A	D	7¼	
30	M. C.	I		9	11.5	July, 1918	Dr. Jellett	D	A	5¾	
31	C. D.	I		8.6	....	July, 1918	Dr. Jellett	A	A	6⅛	
32	M.O'T.	IX	I Forceps; dead II Forceps; dead III Forceps; dead IV Pubiotomy; alive (vide No. 7) V Transverse; podalic version dead; Jan.. 1913 VI Forceps; alive VII Forceps; dead VIII Breech; alive	7	....	Sept., 1918	Dr. Jellett	A	A	7⅛	
33	S. W.	I		7.7	13.7	Jan., 1919	Dr. Jellett	A	D†	9⅛	
34	S. H.	II	I Forceps; dead	8.4	11.8	Jan., 1919	Dr. Jellett	A	A	7¼	
35	M.McT.	V	I Spontaneous; dead II Transverse; dead III Cæsarean section; alive IV Cæsarean section; alive	7.5	12.5	Jan., 1919	Dr. Jellett	A	A	6½	

*Died in 10 minutes. Hydrocephalic and spina bifida.
†Hydrocephalic.

other causes do. There is always bound to be a certain amount of hæmorrhage at the moment of operation as a result of small injuries to the vulvar venous plexus. This blood cannot readily escape and consequently tends to dissect a space for itself between the bone and the mucous membrane, and there to form a hæmatoma. Further, at the point of separation of the ends of the bone, there is a gap which leaves the vaginal walls unsupported. As a result, when the vagina is forced to dilate by the descending head, it tends to tear where it is unsupported, and this tearing is made more extensive by the hæmatoma behind it. Such an accident is most prone to occur when delivery is effected in primiparæ by the forceps immediately after the pubiotomy. It is less likely to occur if delivery is spontaneous, and still less likely to occur if the operation has preceded

labor by some days or weeks. In other words, the more complete the recovery of the soft parts from the trauma of the operation, the less likely is laceration to occur, and the smaller will be its effects if it should occur. This suggests that the ideal time at which to perform pubiotomy is when the patient is not pregnant, because then the vulvar blood supply will be at its smallest. Indeed, the only objection that can be raised to such a practice is that the patient might never require the effects of the operation, that is, she might never again become pregnant. When, however, future pregnancies are fairly certain to occur, I should advise operation independently of them. Further, I think it is a matter for consideration as to whether, when, in a primipara, the existence of contraction is not recognized until the patient is in or very near labor, we should not deliver her by cæsarean section, and perform pubiotomy at a subsequent date for the benefit of future labors.

5. *Every effort should be made to prevent bony union of the cut surfaces.* I think I am right in saying that when pubiotomy was introduced one great advantage it was said to possess over symphysiotomy was that bony union of the cut surface usually followed. This was believed to be an advantage because it was supposed that without such union the pelvic girdle would be impaired, and there would be interference with the power of walking. Such a supposition is, of course, untenable, as is amply proved by cases in which the piece of bone between the saw cut and the symphysis has come away without harm to the patient, and by the ambulatory powers of women who have been born with a split pelvis. On the other hand, the occurrence of bony union prevents any considerable permanent increase in the size of the pelvis, and prevents any separation of the bones during labor. It can best be avoided by refraining from the prolonged use of the pubiotomy belt, by allowing patients early movement, and by getting them out of bed as soon as possible after operation.

The following history is an interesting example of the importance of this point:

Mrs. M. G. (Case No. 17), pelvis measuring 9.3 centimeters in the conjugate and 10.5 centimeters in the transverse, had pubiotomy performed by me in November, 1913, a living child being delivered. According to the practice of that date, she was kept very quiet after the operation with the result that bony union took place at the incision. She returned to the hospital in February, 1916, and in consequence of the failure of the head to enter the brim, Dr. Purefoy had to perform a second pubiotomy on the opposite side, a living child being extracted by the forceps. She came into hospital again in January, 1919, the condition then being that my incision was united by bony union, and the incision left by Dr. Purefoy by fibrous union, as diagnosed at the time and as proved by a subsequent roentgenogram. The membranes had ruptured before admission, and the patient had very poor uterine contractions. She was given every opportunity to deliver herself, but this failing owing to the weak contractions, I had to apply the forceps and delivered a living child without the smallest difficulty.

I think this case conclusively proves the advantage of a non-rigid union of the bones.

It may be asked if it is possible to guarantee a non-bony union by the means I have suggested, and the answer will be that it is not possible to do so, but that such union is most likely to result, if we deliberately try to produce it. If, on the other hand, further experience goes to show that bony union does result in some cases, in spite of every effort to prevent it, then there will be a legitimate reason for adopting some method which will positively prevent it. Such a method might be found in the removal of the fragment of bone between the saw-cut and the symphysis, a procedure which does not seem to give rise to any inconvenient consequences. For the moment, however, results appear to indicate that such a step is unnecessary. Once it is shown to be necessary, I do not see that we need have any hesitation in adopting it.

It may further be asked, whether, even if non-bony union results, its fibers will stretch sufficiently to allow increase in size of the pelvis at subsequent labors. Here, I think, we are on surer ground. So far as my own experience goes, at any rate, delivery occurs without difficulty. The explanation is probably to be found in the softening and general relaxation which is known to occur in the fibrous ligaments of the pelvis toward the end of pregnancy, and which permits a slight

temporary increase in the pelvic diameters during labor. In this case again, if a more extended experience shows that a sufficient increase in the pelvic diameters is not to be obtained in this way, it is possible that a bone grafting operation might give good results. For the moment, however, as I have said above, results appear to indicate that such a step is unnecessary.

The difficulties in the way of adopting such procedures as either excision of a piece of bone, or bone grafting is not to be found in their inherent risks, which only occur once in the woman's life, and which must be far less than the risks of repeated cæsarean sections. They rather lie in the direction of determining whether the operation will be subsequently needed or not. My point, however, is that, if the patient wishes to have, and is likely to have, further pregnancies, even a bone grafting operation is a preferable procedure, once it is proved to be necessary, to repeated cæsarean sections.

It is also possible that both bony and fibrous union might be avoided by exposing the line of incision and bringing a piece of the pubic fat between the bones. On these points, however, I do not want to express a definite opinion, first, because I do not know that any of them is necessary, and, second, because I only want to insist on facts which I regard as established.

The foregoing five points constitute the main argument of this paper, but I should like to supplement them by a few words on certain alterations in the usual technique of the operation.

The first point on which I must insist is the necessity for accurate measurement of the internal diameters of the pelvis, and the exclusion of such degrees or types of contraction as we cannot hope to overcome by division of the pubic bone. It is extraordinary that, at the present day, there are still so many obstetricians, possessing the highest skill and knowledge, who consider they cannot measure a pelvis with Skutsch's pelvimeter, or who think that its use is unnecessary. I am aware that great advances have been made in measuring by means of X-ray photographs, and such results are probably quite satisfactory if obtained by a roentgenologist accustomed to make them. The clinical difficulties in the way of the general extension of the practice are, however, very great. The ordinary error of a man accustomed to the use of the Skutsch instrument ought to be something less than 0.3 centimeters, and this gives sufficiently good working results. The necessity for accurate measurement lies in the necessity for excluding from operation cases in which the pelvis is too small to allow the subsequent delivery of the fœtus alive and in good condition, without injury to the mother. The lowest limit is, I think, rightly put at 7 centimeters in the case of a flat pelvis, and 7.5 centimeters in the case of a generally contracted pelvis. The first case on which pubiotomy was performed in the Rotunda Hospital is an example of the results of operating below this limit. In this patient the conjugate measured 6.5 centimeters. The child, it is true, was delivered alive, but, of her four subsequent labors, one ended in craniotomy, and three in cæsarean sections. I have excluded this case from my statistics because it does not fulfill the conditions laid down. We have no record in the hospital of any similar case so far as subsequent labors were concerned.

I do not propose to enter into a description of the operation itself as it is too well known. There are just a couple of points to which I must refer. I do not like Bumm's sharp pubiotomy needle, because its point, if pressed against the bone, tends to stick in the latter, and, if allowed to leave the bone, tends to wander into the bladder. I use a blunt Dœderlein needle, the elbow of which I have straightened so that it is no longer right-angled, but carries its curve in the continuation of the handle as in the case of Bumm's needle. This necessitates making a nick in the skin to allow its entrance, and another for its exit.

I think it is a matter for further consideration as to whether the subcutaneous method is advisable when the operation is performed under the most favorable circumstances. When the operation is done at the end of labor, just prior to delivery, the subcutaneous method undoubtedly possessed advantages.

On the other hand, I am inclined to think that in operations done at the time of election, it will be found wise to make a small incision above the pubis, to separate the bladder from the back of the pubic bone in the region of the saw-cut, and to pass the needle from above downward. I think this is a more surgical performance and therefore likely to be adopted.

If the subcutaneous method is adopted, the condition of the inside of the bladder must always be examined. This should be done as soon as the needle has been passed and before the saw is pulled into place, with the object of excluding positively the entrance of the needle into the bladder. My own practice is to pass a catheter as soon as the needle has been introduced. If any drops of urine in the bladder are clear, it is a sign that all is well. If, on the other hand, there are any drops of blood, then a little fluid should be injected into the bladder and the anterior wall carefully examined with the catheter in order to detect by sound and touch whether the needle has really entered or not. The presence of a little blood in the urine does not necessarily mean penetration of the bladder wall.

If penetration does occur, then the operation must be abandoned for the time being, if it is possible to do so, and, when next attempted, should be done by the open method at the opposite side. If its immediate performance is essential as in the case of a patient well advanced in the second stage, the same course must be adopted. On no account is it permissible to pull the saw into position by a needle which has penetrated the bladder, as, subsequently, the included bit of bladder wall would be cut through by the saw, and a large opening result. On the other hand, a mere puncture is probably of little importance if care is taken to empty the bladder at short intervals during the next week.

The only objection that can be legitimately urged against pubiotomy is the slight uncertainty that exists as to the exact position of the needle point at the moment it is passing over the upper margin of the pubis. This uncertainty added to the slight variation that may exist in the exact relation of the anterior wall of the bladder to the same region, may result in perforation of the bladder wall. It is for this reason that I so strongly urge the performance of the operation as long before labor as possible, because then all uncertainty can be removed by performing the operation by the open method.

At the present time, it is very difficult to get an opportunity of examining patients suffering from deformity previous to labor, because, neither the patient herself nor the general practitioner who knows of her case, appreciates the importance of an early diagnosis. This, however, is only a matter of education, and, once its importance is recognized, then women, in whom deformity is suspected, will come under treatment in good time. The object of this paper is to remove the false impressions that surround the operation and any intrinsic uncertainties that attach themselves to its performance. Hence, I strongly urge on medical men the necessity for early diagnosis in order that early treatment may follow.

I may say a word to emphasize the importance of using sharp saws. Operators of non-mechanical tendencies are apt to think that because the instrument once was a saw, it remains so indefinitely. This is a fallacy which leads to a lengthy forcing of the saw through the bone with attendant sawing of the skin and soft parts.

The after-treatment of the case is of much importance. Bony union being not only unnecessary but detrimental must be avoided. At the same time the necessary approximation of the bones must be ensured. I am inclined to think that, even if no particular care is taken, this approximation will occur spontaneously. It is, however, well to apply a pubiotomy belt as soon as the operation is done, and to have the belt in place during labor to avoid undue separation of the bones. On the other hand, it must not be too tight to allow the correct amount of separation. It may be taken off as soon as the bones tend to remain in fairly close apposition of their own accord, and this will be probably about the fourth or fifth day. Any movements of the patient which do not cause pain may be allowed. There should be little or no tenderness in the region of the incision and its

occurrence usually shows that some infection has occurred. The patient may leave her bed, if convalescence has been normal, any time after the tenth day when there should be no impairment of walking power other than a slight stiffness which soon passes off.

CONCLUSIONS

In conclusion, I should like to suggest that there are certain points in regard to pubiotomy which we must consider to be proved, and which may be summarized as follows:

1. Pubiotomy is a safe operation.
2. It both enables a particular labor to be terminated satisfactorily, and it cures certain degrees and types of contracted pelvis.
3. It should be performed as long before the delivery of the patient as possible.
4. Bony union of the cut surfaces is unnecessary and disadvantageous.

On the other hand, there are certain points which are still to be decided, and among them I may mention three:

Should pubiotomy be performed independently of pregnancy and labor?

Should it be done by the open method?

Should any special steps be taken to prevent bony union?

Prima facie, it would appear as if the first two questions at all events should be answered in the affirmative, and that by so doing we shall prevent complications.

It seems to me that it will require some very powerful, not arguments but facts, to disprove the statements I have made in the foregoing paper, and the consequences I have deduced from them. They will certainly not be disproved by the old fable of the number of crippled women who have been seen after pubiotomy, because I do not think anyone quite believes in them any longer. Nor can that very hoary obstetrical stumbling block serve as an obstruction—that the operation is unsuitable for performance by the general practitioner. Of course, it is unsuitable, if for no better reason than that the only cases, in which he is likely to be called on to perform it, are those in which immediate delivery is necessary, and in which, consequently, it is most likely to be difficult and complicated. But, surely, obstetrical specialists must be very hard set for an objection, if they have to resort to one of this type.

TABLE II.—NATURE OF PREVIOUS LABORS

Nature of Labor	Number	Result to Child	
		Alive	Dead
Spontaneous	12	6*	6
Induction	2	1	1
Forceps	21	4	17
Version	2		2
Craniotomy	4		4
Symphysiotomy	1		1
Unclassed	3	—	3
Total	45	11	34

*Two of these were premature.

TABLE III.—NATURE OF PUBIOTOMY LABOR

	Cases
Number	35
Mothers alive	33
Mothers dead	2
Children alive	31
Children dead	5
Causes of maternal deaths:	
Collapse due to fatty degeneration of the heart	1
Acute miliary tuberculosis	1
Causes of fœtal deaths:	
Prolonged labor	3
Second of twins	1
Hydrocephalus	1

TABLE IV.—NATURE OF SUBSEQUENT LABORS

Nature of Labor	Number	Result to Child	
		Alive	Dead
Spontaneous	11	11	
Forceps	7	6	1
Version	2		2*
Pubiotomy	2	2	—
Total	22	19	3

*One death due to placenta prævia.

The part to be played by the general practitioner in regard to pubiotomy is of considerable importance. It consists in sending patients, in whom he suspects the existence of contracted pelvis, for accurate diagnosis and surgical treatment at as early a period in pregnancy as possible, or even before pregnancy occurs, and not, as is so often the case at present, after the patient has come into labor.

I said at the beginning that plain speaking was necessary, and now I make no apology for my last sentence. The operating obstetrician and gynecologist of today has no right to allow himself to be prejudiced by the unproved criticisms and traditions of others in regard to an operation which offers so much benefit to the great majority of women suffering from contracted pelvis.

A FEW OF THE FACTORS THAT ENTER INTO THE SURGERY OF THE PROSTATE[1]

By JOHN B. DEAVER, M.D., F.A.C.S., Philadelphia

THE bearer of an enlarged prostate, or the prostatic, as he is often laconically termed, is at times one of the perplexing problems of the surgeon. We have generally to deal with a patient presenting many of the disadvantages of advancing years which of themselves may contraindicate operative interference. On the other hand, such good results follow prostatectomy that we are often tempted to take the offchance. It would, of course, be folly to treat every instance of prostatic hypertrophy with prostatectomy. In some cases it would be entirely too drastic a procedure compared to the clinical symptoms; while in others it would only mean making a bad condition worse.

The surgeon, naturally, rarely sees that class of cases in which the urinary disturbances are limited to frequency, usually nocturnal, and painful tenesmus of the sphincter muscle with interrupted or sluggish urination. These cases very often yield to treatment, dietetic—non-irritating foods—or local in the shape of massage, baths, etc.

It is when this treatment fails that retention begins and the patient seeks surgical relief. When he finally comes under our care there are several important points to be considered before deciding the question of operation. First among these is, of course, the condition of the patient's heart, blood-vessels, and his general condition. Then the careful examination of the prostate, first by rectum and then with the aid of the cystoscope. But before making the cystoscopic examination the patient should have been resting in bed for at least twenty-four hours, and have been receiving medication in the shape of urotropin and quinine. The cystoscope will often give definite information as to the nature of the disease or the enlargement, whether it be benign or malignant; it reveals the condition of the bladder, the presence of a foreign body, the condition of the urethra and of the kidneys, permits estimation of the amount of residual urine, and often determines the operability of a given case. It is well, before introducing the cystoscope, and certainly after cystoscopy, to place for a short time a soft rubber in-dwelling catheter, the length of time for its retention depending on the amount and the character of the urine that is being passed. The value of the in-dwelling catheter, whether or not in the presence of kidney insufficiency or any other kidney condition resulting from or accompanying the prostatic enlargement, surely admits of no argument.

A not infrequent accompaniment of prostatic enlargement is vesical calculus, generally considered to be the result of residual urine, but which may also be its cause owing to the irritation to the bladder and consequent vesical as well as prostatic congestion. Removal of the stone relieves the congestion and sometimes also the urinary obstruction by reduction of the prostatic enlargement. But when the enlargement of the bladder is not a temporary one the question of removing the prostate at the same time as the stone is a matter of judgment on the part of the surgeon, much depending on the general condition of the patient, the presence or absence of infection.

The continued presence of residual urine throws an added strain on the bladder muscle the walls of which in time hypertrophy, and unless the obstruction is relieved we have that dread condition, atony of the bladder, with its train of possibilities with which you are all familiar: chronic retention, dilatation of the bladder, or fibrous contraction with the formation of trabeculæ and false diverticula that form convenient sites for urinary collection and possibly stone formation. The muscular paralysis can often be somewhat relieved by active attempts at evacuation and mechanical pressure.

[1] Read before the Philadelphia Genito-Urinary Society, January 29, 1919.

The overdistended bladder should be relieved before any attempt is made to deal with the prostate or even to do a cystoscopy. The nervous and cardiovascular system of the average prostatic are very easily deranged and every effort should be made to exclude all factors that might encourage such derangement. In fact, I deem it inadvisable to relieve an overdistended bladder at once with the catheter, but prefer to reduce the amount of residual gradually day by day, until the bladder is finally allowed to remain empty by the permanent inlying catheter. The cystoscope in this class of cases should be used with caution, especially in pronounced enlargement with considerable residual urine, a condition in which injury is easily inflicted.

Another question that determines the operability or inoperability of a given case is carcinoma. Carcinoma of the prostate does not produce urinary obstruction until the carcinoma is well advanced, since it usually develops in a non-hypertrophic portion of the gland and nearly always in the posterior part of one of the lateral lobes. The cancerous process remains within the confines of the prostatic tissue for a long time before it invades the neighboring tissues. The obstruction is generally due to enlargement of the median and the anterior portion of the lateral lobes, for in about 50 per cent of the cases carcinoma and hypertrophy of the gland are associated, although in their early stages both processes are separate and distinct (Judd). When the enlargement is such as to cause obstruction the patient will probably seek relief before the carcinomatous condition has advanced too far to preclude operation. In a few favorable conditions complete enucleation of the gland may be attempted but, as a rule, the only surgery, if any, that can be offered is palliative relief in the shape of partial prostatectomy. Radium treatment has its advocates, but I am not one of them. I have seen few if any favorable results therefrom.

The differentiation between benign hypertrophy and carcinoma is often possible by means of cystoscopy and also by urethroscopic examination. With the latter, as demonstrated by Braasch, there is visible a distinct sulcus between the lateral lobes in cases of hypertrophy, while with carcinoma instead of the depression there is seen a median elevation in the floor of the urethra and a longitudinal narrowing of the lumen; the urethra also appears corroded, and bleeds easily when the urethroscope is introduced.

No surgeon is going to run the risk of operating upon a prostatic before determining the functional capacity of the kidney. And, as you well know in the color elimination test and the estimation of the urea of the blood and the urine we have the most reliable and accurate tests that the modern laboratory furnishes us. I have used these tests in hundreds of surgical cases of every description and I have no hesitation in acclaiming their value. Any question of their reliability I confess neither impresses me nor influences me against their continued use. But I am only repeating my constant contention, when I say that even with such reliable laboratory aids, we cannot afford to ignore the valuable information derived from the clinical history and the physical examination of the patient himself. Nearly all, if not all, instances of enlarged prostate demand drainage of the bladder. Very often the relief afforded leads to such satisfactory general improvement that operation can be undertaken even though the functional test and the specific gravity of the urine are low; and vice versa, without such general improvement operation is often inadvisable in spite of the satisfactory results of the laboratory tests. This is, of course, subject to limitations. You all, no doubt, are daily confronted with instances in which for some reason or other the general condition fails to improve; then the kidney functional test is the only guide in deciding for or against operation. Sometimes this failure to improve is due to infection from the residual urine, a condition which adds greatly to the risk of prostatectomy. It is important to increase resistance to infection by suitable measures the most valuable of which is prolonged bladder drainage. The urine should be studied bacteriologically. If, as is often the case, the colon bacillus is grown in culture, the question of an autogenous vaccine, as recommended and practiced by

Judd, to increase the patient's resistance, should be considered.

In every operative case there are three stages—before, during, and after, the operation. Of these the first is the most important. The third stage, getting the patient well, is the next in importance, while the second or operative stage is the least important of the three. In this I believe every experienced surgeon will concur.

Having carried the patient satisfactorily through the first stage the next question is the choice of operation. To my mind for the great majority of enlarged prostates there is but one operation, the suprapubic. The infrapubic operation is, first of all, safe only in the hands of the master operator and if indicated at all it is in the presence of a comparatively fibrous and in the carcinomatous prostate, and in either instance only when the patient is of comparatively lean build. For this type the Young operation is to be preferred since it enables the operator to see well what he is doing and thus to do well what he sees to be done.

To discuss the superiority of the suprapubic over the infrapubic would not only be out of place before a society of gentio-urinary surgeons but it would occupy time which I hope to use to better advantage. The advantages of the suprapubic method of removal of the prostate can be expressed by the statement that sight gives insight. Every nook and corner, as it were, of the bladder cavity can be surveyed as well as palpated to a certainty which cannot be done by the infrapubic operation. It may be argued that this is the purpose of the cystoscope. Well and good, but the cystoscope does not give the same degree of certainty as the naked eye. Seeing the interior of the bladder, noting the color of the mucosa and its character, observing the site of macroscopic foci of infection, if present, whether the mucous membrane is softened and bleeds easily, all of these are guides in determining whether or not it is best to do a two-stage operation. This I regard as one of the most important, if not the most important question in the surgery of the enlarged prostate, and on the decision often depends the successful issue of the case.

In taking a stand in favor of a two-stage operation, I am aware I am doing so in opposition to some of our very best surgeons, but nevertheless, to my mind this does not affect the soundness of my position. The two-stage operation together with the careful preoperative treatment of the patient contributes greatly to the low mortality of the operation of prostatectomy.

The two greatest dangers presented by the operation are uræmia and hæmorrhage. The former still figures, but inconspicuously so, if the case has been carefully studied as I have outlined. In this connection before going further let me say that a patient, even though functional tests are good, heart and blood-vessels in fair condition, as far as can be determined, blood pressure and sphygmographic tracings being by no means infallible, even if there is no history of shortness of breath or attacks of dyspnœa, cardiac cough, or dizziness and the bladder even on inspection appears perfectly satisfactory, is not a case for immediate removal of the gland if he has been passing huge quantities of limpid urine with low specific gravity. It has been my experience that this is the type of case likely to develop a uræmia of the chronic variety. If the two-stage operation is performed under these circumstances uræmia, although it occasionally does, is much less likely to occur.

In doing either the two-stage or the complete operation at one sitting, I have yet to see a prevesical abscess result, provided the vesical fatty tissue is incised and not scraped aside with the tip of the finger or with the end of the handle of the scalpel, bleeding being arrested by ligature, and the prevesical space drained by rubber dam.

In controlling the bleeding no pieces of the gland should be left in, or else the prostatic bed will not contract sufficiently to minimize the chance of bleeding. The principle is the same as in the bleeding from the uterus following abortion where particles of placenta are retained.

I have seen but one patient perish from hæmorrhage; this followed a suprapubic removal and could have been prevented had the gravity of the bleeding been recognized and the surgeon reached the patient in time.

When in doubt as to the extent of the bleeding the only safe course to pursue is to pass a suture around the bladder margin of the prostatic bed much in the manner of a purse-string, then a small gauze pack, the free end of which is brought out of the wound alongside of the tube, is placed in the bed and the suture tightened. This absolutely controls the bleeding.

I, and doubtless many others, have had narrow escapes from having patients bleed to death by failure to pack the prostatic bed at the time of the operation, in the hope that the bleeding would cease spontaneously. I have taken this chance because having the patient in the hospital and being within call I could act promptly in the event of any untoward occurrence. Upon two occasions I have had to re-open the bladder wound, clean out the blood clots and pack the bed, both patients making a smooth recovery.

As to the choice of anæsthetics, nitrous oxide and oxygen anæsthesia suffices in many cases and generally for the first stage of the operation, and has no deleterious effect upon the kidneys. I grant that for the secondary operation it is not so desirable since the abdominal walls are not relaxed as in ether anæsthesia, yet this is not of great moment unless the enucleation be a difficult one due to peri-prostatic adhesions, etc. On general principles nitrous oxide anæsthesia is contra-indicated where the blood pressure is very high, though I occasionally give it in such conditions. In most such cases chloroform or intraspinal stovaine anæsthesia is more useful. But ether is the safest and in the average case is the anæsthetic of choice.

Local anæsthesia I have no experience with, my time being too much occupied by numerous operations to permit wasting any of it in practicing this form of anæsthesia.

In the after-care of patients the watch-word is of course kidney function. I do not permit my patients to get out of bed as early as do some surgeons, although the practice may be a good one. I believe in slowly increasing the general régime and diet.

When a two-stage operation is chosen, before the second stage or the enucleation is resorted to, the functional tests should be made as before any operation, thus adding to the safety of the procedure.

As to sequelæ, fistula does occasionally form after the suprapubic operation but in my experience it has always been temporary. When it does occur shortly after the suprapubic wound has healed, it can be corrected by the passage of bougies. Stricture may follow either the suprapubic or the infrapubic operation. I have seen it in a few cases.

Permanent incontinence I have not seen following the suprapubic, but have seen it after the infrapubic operation. I have also seen permanent fistula follow the low operation.

Epididymitis, phlebitis, parotitis, acute cardiac dilatation, and pulmonary embolism are known to have occurred.

Points I have not seen mentioned are the shrinking of the gland that occurs after the first stage in a not inconsiderable number of cases; and also that the bleeding after the removal of the prostate in a two-stage operation is not so profuse as after the one-stage operation.

INFECTIVE ("SECONDARY") HÆMORRHAGES FROM WAR WOUNDS

A Clinical and Pathological Study

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IN the accessible literature we find that the subject of secondary hæmorrhages is briefly treated, conflicting views are expressed, and very little evidence is advanced to support the various statements that are made. Exhaustive articles upon the complications of war wounds barely mention the condition. Some writers hold that secondary hæmorrhage should never occur if wounds are treated adequately primarily, maintaining that the injured vessel will have been found and adequately cared for. Secondary hæmorrhage is believed by other authors to be due to infection added to the primary injury of vessels. A third group assigns an insignificant rôle to the original injury, believing infection to be the essential cause. The treatment of secondary hæmorrhage is usually dismissed either with the statement that the vessel should be ligated in the wound at the site of the lesion, or that it should be ligated proximally to the wound. We have been unable to find any description of the pathology of secondary hæmorrhage in war wounds (or in civil practice). The following analysis of the material seen in our hospital during the past year is presented because we have found secondary hæmorrhage to be a serious complication, one of the first importance, in war wounds.

The reason for adopting the term "infective hæmorrhage" should be explained at the outset. "Secondary hæmorrhage" is a rather loosely used expression to describe all but primary hæmorrhages; it is secondary or consecutive to a variety of causes. As will be shown, our study demonstrates that infection was the sole cause of the hæmorrhages ordinarily classified as "secondary." "Infective hæmorrhage" is a term that particularizes this class of cases and will therefore be employed.

Infective hæmorrhage occurred in 45 patients of a total of about 5000 surgical cases that passed through the hospital in one year (1 per cent). Many of these cases were minor ones, others did not require surgical intervention. Its incidence is therefore better appreciated in the statement that 65 of a total of 2332 operations were undertaken for its control (2.79 per cent). The occurrence of infective hæmorrhages varied considerably with the different convoys of wounded but was in general proportionate to the frequency of infection. We gained the impression that it became less common with the wider operative exposures that were more and more frequently practiced. An inspection of the report of our cases shows that infective hæmorrhages occurred most often if more conservative or no operative procedures were employed in the treatment of the wound.

The onset of infective hæmorrhage ranged from 5 to 47 days after the time the wound was inflicted, the average period for the first appearance of blood being 12.8 days. We say "first" because in none of our cases was there any evidence that previous delayed hæmorrhages had occurred. It is difficult to state when the danger of infective hæmorrhage is past. In one of our cases, for example (Case 5), a hæmorrhage occurred 12 weeks after the wound was received. Many of our patients were under observation for very limited periods. From the study of our material all that can be said is that the danger of infective hæmorrhage is over only when infection has ceased.

By referring to the report of cases it will be noted that recurrence of infective hæmorrhages of slighter degrees was not at all uncommon. This question is of much clinical importance. One sees that the slighter hæmorrhages were usually treated conservatively, operations aiming to discover the cause of and to control the bleeding, being performed only after the hæmorrhages had recurred once or oftener. That the lesion then dis-

closed was usually a defect of the main artery in the region of the wound, and that the hæmorrhages were slight only because of thrombotic obturation, will be subsequently indicated. The fact we wish to emphasize here is that a slight degree of hæmorrhage is absolutely no guide to the size of the vessel involved or to the extent of the lesion.

The wounds, the source of infective hæmorrhage, varied greatly in size, extent, and depth, many being complicated by fractures. The depth was appreciable in all except the few superficial ones in which the bleeding clearly came from granulation tissue. Major arterial trunks were in most instances in the neighborhood of the wound. Not a single wound in our series was in a clinically satisfactory condition or approached bacterial sterility either at the time of admission to the hospital or when the infective hæmorrhage occurred. In those that appeared to be only slightly infected over their visible surface, the first operative reexposure or the operation for the infective hæmorrhage disclosed more extensive infection in the depths.

In short, infection was present in every case, although to very varying degrees. When widespread it was, of course, impossible to determine a greater or less involvement in the region of the vessel from which the bleeding arose. On the other hand, operative dissection of the vessels in less infected cases not infrequently revealed the maximal visible extension of the infection along their sheaths. If not maximal, the extension in this direction could nevertheless always be determined.

The infected tract led to and a short distance (generally 2 to 3 centimeters) beyond the rupture in the artery. The latter was sometimes adjacent to the wound or amputation stump, but more often some distance central to it. This distance varied from a centimeter or so up to 6 centimeters. The remoteness of the site of rupture from the wound is one of the reasons we have for believing in the non-traumatic nature, of "secondary hæmorrhage" and we therefore wish to emphasize it accordingly. In all the specimens of arteries resected for infective hæmorrhage, the rupture was an oval or elliptical defect lying in the long axis of the vessel. The maximal transverse loss of substance was usually about one-third the circumference of the artery; in only a few instances was it much greater. The margin of the defect was often smooth and rounded off, shaggy and irregular in some cases. A thrombus occupying a varying part of the lumen was occasionally observed. No reference has been made to infective hæmorrhages from vein lesions, for we have neither seen specimens of such lesions nor are there any proved cases of vein hæmorrhages in our series. Up to the present time infective thrombosis of the vein or veins accompanying the diseased artery has been noted at operation in only a few cases, yet it is a most important part of the picture of infective hæmorrhage. This question of involvement of the vein will shortly be discussed.

The following observations on the pathology of the arterial lesions are based upon examinations of 14 specimens removed at operation or from limbs amputated for hæmorrhage and infection.[1] There are considerable variations in the microscopic pictures but a general conformation to a well defined type. The artery is embedded in infected granulation tissue, its adventitia showing a varying degree of round and polynuclear cell invasion. Œdema of the muscularis, so marked as to be readily confused with hyaline degeneration, is common; otherwise the muscular coat is usually normal everywhere down to the immediate vicinity of the rupture. In cross sections through the latter a varying but usually small number of leucocytes is found scattered in the muscularis; in one instance this coat contained a small abscess at a point opposite the rupture. In only one case was the muscular coat entirely destroyed at the level of rupture, having been replaced by partly organized granulation tissue. As the defect is approached the muscle bundles show degeneration, merging into complete and massive necrosis.

It is only here that intense leucocytic invasion of the muscularis is usually seen. The internal elastica is split into numerous snarled strands in the zone of degenerated muscula-

[1] For microscopic study blocks were taken from the defect bearing part of the artery and at various distances above and below this level. In some instances serial sections were taken from these blocks in order to follow the stages of the lesion. Hæmatoxyline osin, Weigert, Van Gieson, and Gram tissue stains for bacteria were employed.

ris. Round cell infiltration and reduplication of the intima are seen at the level of rupture, being most marked in its neighborhood. The intima is often spread like a sheet over the abrupt termination of the media. The open lumen of the vessel, either U or V shaped, frequently contains a thrombus of varying size, always infected, and of fairly or very recent origin in the great majority of instances. In only one case (Case 16) was the thrombus partly organized, of appreciable extent (about 2 centimeters) beyond the defect, and with definite evidence of attempt at repair. The picture was that of a small dissecting aneurism. It is of interest to note, in the history of this case, that the bleeding ceased without operative intervention, and did not recur, the patient dying of other causes. From the examination of our material we believe that the pathological condition preceding open rupture is in all probability this type of small dissecting false aneurism.

Bacterial stains of the arterial sections show various types of organisms ranging from very small streptococci to large thick rods. In some specimens the bacteria are very few in number; in others very numerous and grouped in clumps. They are usually distributed in a rather characteristic fashion, being chiefly found in the peripheral zone of the thrombus, at and in the intima, in the necrotic portion of the muscularis, and in the adventitia. The striking feature is the total or almost total absence of bacteria in the muscularis, except at the site of rupture. Very few organisms are seen anywhere in the vessel wall within a few millimeters of the rupture even when numerous in its immediate neighborhood; beyond this level they are usually no longer to be found except in the thrombus.

Except in the fatal cases there have been very few opportunities to study the vein or veins accompanying the diseased artery. In every instance in which this has been possible, however, the veins have shown pathological alterations ranging from phlebitis with infected thrombus to suppurative thrombosis accompanying extensive involvement of the vessel wall. Thrombi and veins both contain bacteria, generally in larger numbers than in the associated arterial lesions. The post-mortem examination of patients who have had secondary hæmorrhages have invariably shown the presence of infection. This has been systemic in the great majority of cases, with various pyæmic foci, the source of distribution being a suppurative thrombosis of the infected venous trunk accompanying the diseased artery. The entire question of vein involvement in infected war wounds is being studied in the hospital laboratory at the present time. In this place we only wish to point out the frequent association of ofttimes fatal vein infection in cases of infective hæmorrhage from arterial lesions. Limbs amputated for hæmorrhage complicating infected wounds have also shown vein involvement. And, finally, infective hæmorrhage from the stump has followed amputation in cases in which dissection of the removed limb disclosed the presence of purulent phlebitis of main venous trunks.

Before leaving the description of the pathology of infective hæmorrhage, a few related clinical questions should be dwelt upon. In the first place we wish to indicate that the arterial pathology usually parallels the clinical course. For example, the larger arterial defects with little or no thrombosis are found in sudden large hæmorrhages, more or less obturating thrombi accompany slight, repeated bleedings. Early hæmorrhages usually occur in cases of more gross wound sepsis, the artery showing the severer grades of inflammation, with numerous bacteria; on the other hand bacteria are generally scarce and the evidence of arterial infection less marked in the later more delayed infective hæmorrhages. Many interesting details and variations of the pathological pictures have been omitted in order to conform with the essentially clinical purpose of this paper. We have been all the more led to do so because we have found the arterial changes in infective hæmorrhage consecutive to war wounds to be in every way identical with those in two cases of "secondary" hæmorrhage (Cases 40 and 41), complicating ordinary infected wounds of civil life. The pathology of arterial lesions in the latter have no doubt been adequately described although we have been unable to find any reference to it. The point we wish to

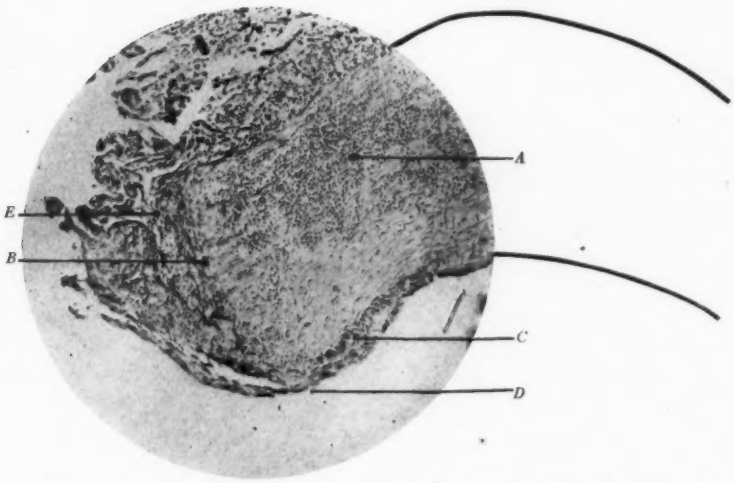

Fig. 1. To show the details of the termination of an arterial wall at the site of rupture. *A.*, Muscularis invaded by polynuclear and round cells, abruptly ending at *B*. *C.*, Internal elastica; *E.;* adventitia folded over muscularis and the intima, *D.*, spread over it. The further outline of the vessel is indicated diagrammatically.

make is that the identity of the two, pathologically, is convincing evidence that a primary wound of the artery need not be invoked to account for "secondary" hæmorrhage from war wounds. In fact the absence of any microscopic signs of previous injury to the artery, the invariable presence of infection, its equal or greater extent in the accompanying veins, are all additional proof that infection, and infection alone, is the common cause of "secondary" hæmorrhage. Our observations are not sufficiently extended to deny the possibility of an untreated arterial wound, with or without added infection, as the primary cause of a "secondary" hæmorrhage, but we certainly see no reason to believe that this is the usual cause.

The ideal treatment of the infective hæmorrhage is of course prophylactic; that is, the prevention or the adequate control of wound infection. It is not germane to our subject to discuss these aspects of wound therapy. Dealing with the already infected wound we wish to discuss the operative procedures involved (in those wounds requiring surgical intervention) only in so far as the vessels are concerned. In the preventive treatment of infective hæmorrhage and vein infection we believe special attention should be paid to the main vessels in anatomic relationship to the wound. If they form part of the immediate wall of an infected tract, they should be adequately exposed in the wound dissection and whatever form of chemical sterilization that is employed should be applied directly to their sheaths. Furthermore, we believe that in infected wounds of several days' duration, such exposure of the vessels in proximity to the wound will not infrequently reveal already existing erosion of the artery and perhaps thrombosis of the vein, for we have had several such experiences. The best treatment for these lesions can naturally be applied if they are encountered in this stage, before a profuse hæmorrhage has occurred and possibly before extensive vein infection is established.

Various methods of treatment have been employed in our hospital for the control of hæmorrhage — packing of the wound, ligation or excision of the artery in the wound, resection of the artery with or without accompanying veins through a separate incision for their exposure (which we have termed "surgical approach"), and amputation. With increasing experience our views have been clarified and procedures originally employed

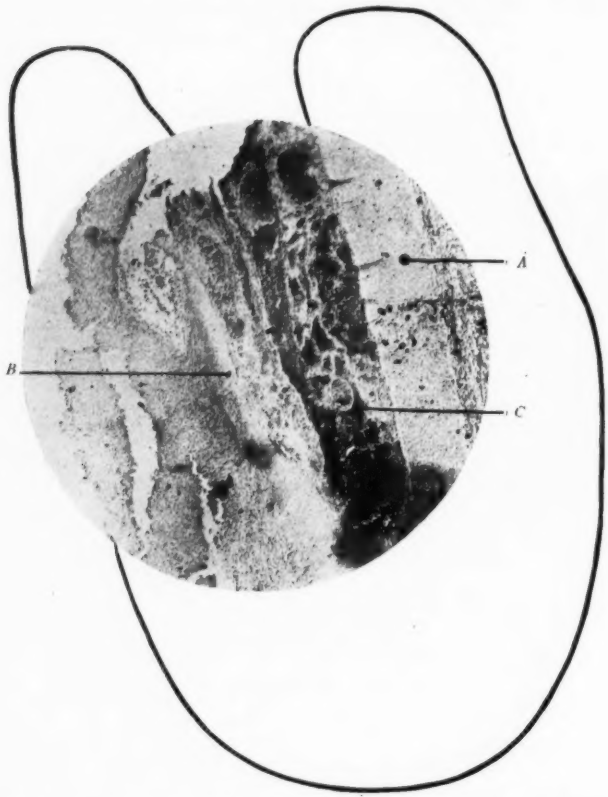

Fig. 2. Cross section through the site of rupture, the remainder of the arterial wall indicated diagrammatically. *A.*, Degeneration of arterial coats; *B.*, suppuration in arterial wall with massive necrosis; *C.*, fresh blood-clot occupying lumen.

would not now be attempted. For example, we have learned, as an inspection of our cases clearly shows, how dangerous or even fatal it may be and often is to temporize with the slighter degrees of infective hæmorrhage by packing the wound. Unnecessary loss of blood and even death from repetition of the hæmorrhage have resulted, and further extension of the infection has occurred, because the significance of these minor hæmorrhages was not at first clearly understood. Except superficial wounds, in which the bleeding evidently arises from granulation tissue, we now know that the hæmorrhage is almost certain to recur and that it comes from an arterial lesion. To defer surgical intervention therefore means in the great majority of cases to permit further loss of blood and to allow sepsis to go on unabated.

Amputation is indicated for most of the cases of infective hæmorrhage from lesions of the popliteal or posterior tibial artery, especially in the existence of fracture. The danger of death from sepsis or recurring hæmorrhage is too great in most cases of this type to attempt to control the hæmorrhage alone. Several of our earlier cases clearly support this statement. A discussion of the technique of amputation is out of place here, but we wish to take up the treatment of the vessels when amputation is performed. In our series there will be noted several cases of in-

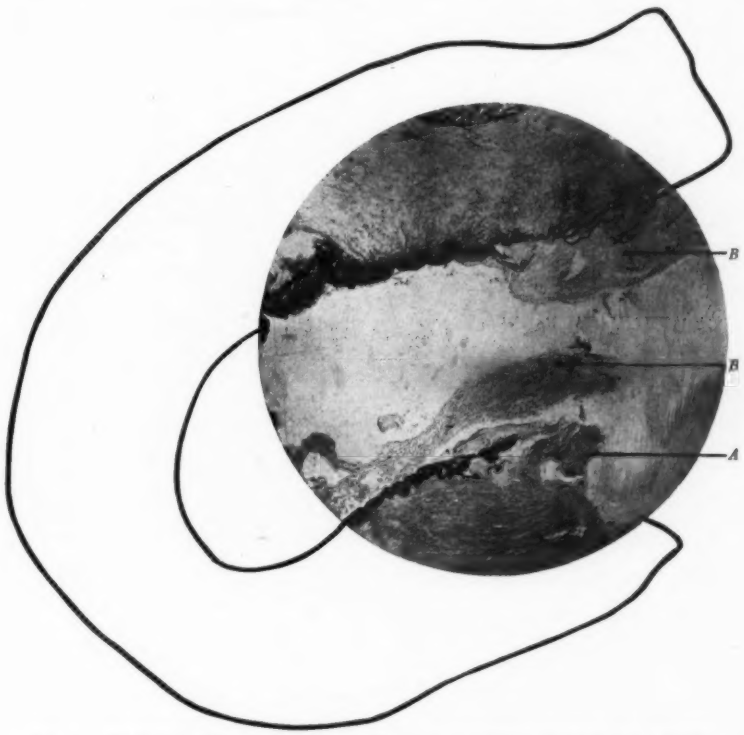

Fig. 3. Weigert stain of cross section of artery at rupture to show the internal elastica, the abrupt termination of the vessel at *A*., and the small thrombi, *B*., *B*.

fective hæmorrhage from the arterial stump after amputations for infection complicated by hæmorrhage or for infection alone. Ligation of the artery at the level of amputation is therefore not sufficient when the amputation is performed through an infected field. If the patient's condition permits the little additional time, we believe the main artery should be tied off in a non-infected area and should usually be removed below the ligature even if it is necessary to dissect centrally for some distance to find that zone. At the same time the main venous trunk should be examined to determine if it is the seat of an infective phlebitis; excision beyond the purulent thrombus must, of course, then be performed if at all possible.

Finally we come to the question of the treatment of arterial lesion in infective hæmorrhage, in the large group of cases in which amputation is not indicated. Our case reports show that hæmorrhage recurred in 50 per cent of the operations consisting in ligation or resection of the artery in the wound or amputation stump and did not recur in any of the cases in which the artery was surgically exposed and resected in non-infected or comparatively little infected fields. There are other arguments against ligation of the artery in the wound: (1) The source of hæmorrhage cannot always be discovered or the rupture itself may be overlooked; this was true in several of our cases, recurrence of the bleeding leading to renewed search for the vessel; (2) It is sometimes difficult to place satisfactory ligatures upon the artery in the depth of the wound, the exposure being necessarily inadequate and the vessel wall often friable; (3) The infected tract along the vessels is not laid open by ligation in the wound and there is

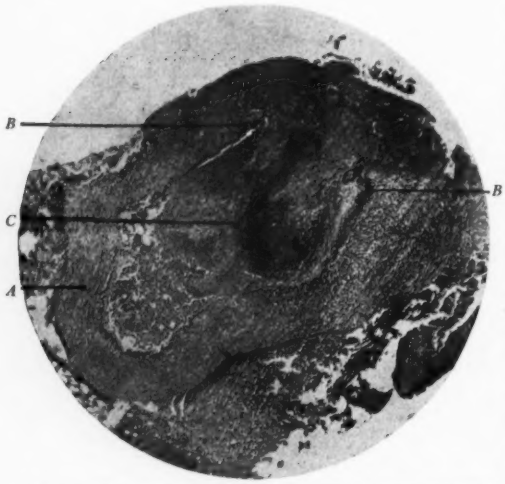

Fig. 4. Obturating thrombus, *C.*, occupying lumen at site of rupture. The muscularis is normal except for œdema at *A*. Note the termination of the elastica at *B.*, *B.*

no opportunity to determine the condition of the accompanying vein. The only argument we have seen advanced against ligation by surgical approach appears based upon the belief that the vessel must be ligated at a considerable distance from the wound, with the possibility of resultant devitalization. In only two cases in our series (Cases 4 and 5) was high ligation performed and it was done solely because the site of the lesion was not determined. Subsequent wound repair progressed satisfactorily in both instances. Had devitalization or gangrene developed the cases could still have been classified as exceptional ones with exceptional operations performed for the conditions encountered. The source of bleeding *can* be discovered in the great majority of the cases and the resection of the artery is almost invariably made not far from the confines of the wound. We, therefore, strongly advocate the surgical approach whenever feasible, to the artery, through a separate incision, its double ligation beyond the rupture and the infected tract, and the resection of the portion between the ligatures.

The likelihood of infection of the accompanying veins is so great that they should be resected at the same time unless they are important venous trunks. In the latter case examination should be made for the presence of an infective phlebitis. If this exists, the indication is clear. We have not as yet reached a definite conclusion upon the treatment of major veins when there is no visible evidence of their involvement, for several of our patients have recovered without ligation or resection of such veins. At the operation for the hæmorrhage one method would be the repeated aspiration of the vein under careful aseptic precautions to attempt to discover a thrombus. Failing this, further treatment might await the bacteriological examination of the aspirated blood and as well the subsequent clinical course; on the other hand, infected thrombi may be present in the vein when fluid blood has been obtained (as in two cases seen in our hospital), and a possibility of vein contamination following aspiration always exists. The argument against resecting the vein with the artery, without knowing whether there is vein involvement or not, loses much of its force because the contributions made to the study of arterial lesions during this war appear to have definitely established the greater likelihood of a satisfactory circulation and the smaller chances for gangrene if the accompanying vein is ligated or excised when a torn artery is ligated or an aneurism resected. For these reasons, but especially because of the probability of vein involvement in infective hæmorrhage, we are at present inclined to believe that the accompanying vein should be ligated or resected even if an important trunk.

In conclusion we wish to thank Captain Alwyn Pappenheimer in charge of the pathological laboratory, for his guidance and aid in the work and the medical officers of the hospital for valuable suggestions and co-operation.

REPORT OF CASES

The cases are grouped according to the arteries involved. All cases are included in which the clinical notes mention the occurrence of hæmorrhage other than clearly primary or delayed primary hæmorrhage. When the notes are incomplete, or the source of hæmorrhage not determined, question marks are used. The only wounds mentioned are those from which hæmorrhage arose even though other more serious wounds co-existed.

FEMORAL ARTERY

CASE 1. Infected compound fracture of middle third of femur. The patient was admitted to the hospital on the second day after the receipt of the

wound. The wound was incised and the purulent discharge began to decrease. On the seventeenth day after injury the patient had a slight hæmorrhage due to a small perforation in the femoral artery. The hæmorrhage ceased spontaneously but amputation was done on the twenty-seventh day because of the continuation of sepsis. The patient died on the fortieth day after injury. Postmortem examination showed an extensive purulent thrombosis of the femoral vein extending into the common iliac.

CASE 2. Infected compound fracture of lower third femur. The patient was admitted to the hospital on the twelfth day after injury, at which time he had a profuse hæmorrhage, the source of which was unknown. The wound was packed and on the fourteenth day amputation was done because of the infection. On the thirtieth day he suffered another moderate hæmorrhage, source unknown, and an abscess in the stump at site of vessels was incised. The bleeding vessel was not found. The hæmorrhage ceased spontaneously. On the thirty-fourth day the patient had another moderate hæmorrhage which was found to be due to a large defect in the femoral artery at 3 centimeters above the stump. There was an infected tract along the vessels. Treatment: resection of artery in healthy area 5 centimeters above the rupture (surgical approach). The result was satisfactory and the patient was evacuated on the fifty-fourth day.

CASE 3. Infected thigh wound in region of vessels. The patient was admitted on the second day after injury and the wounds were dressed. The patient's condition was unsatisfactory. He had a septic temperature although the wound was apparently improving. On the thirteenth day the vessels were explored and an infection was found along the vessels. On the twenty-third day there was a severe hæmorrhage due to rupture in the femoral artery. The artery was divided between ligatures. The patient died on the thirty-second day. Postmortem examination showed purulent phlebitis of femoral vein extending into vena cava, and pyæmic foci.

CASE 4. Compound fracture of lower third of femur, slightly infected. The patient was admitted on the second day. The Carrel-Dakin treatment was administered and the patient improved. From the twentieth to twenty-third days there were slight hæmorrhages and on the twenty-fourth day a profuse hæmorrhage. The source of these hæmorrhages was not known. The four slight hæmorrhages were controlled by packing each time. In the case of the profuse hæmorrhage it was necessary to ligate the femoral artery above the level of the wound. This produced a satisfactory result and the patient was evacuated with solid union.

CASE 5. Infected thigh wound; femoral artery doubly ligated for injury. The patient was admitted on the fifth day. The wound was dressed and the infection was partly controlled. On the thirteenth day there was a severe hæmorrhage, source

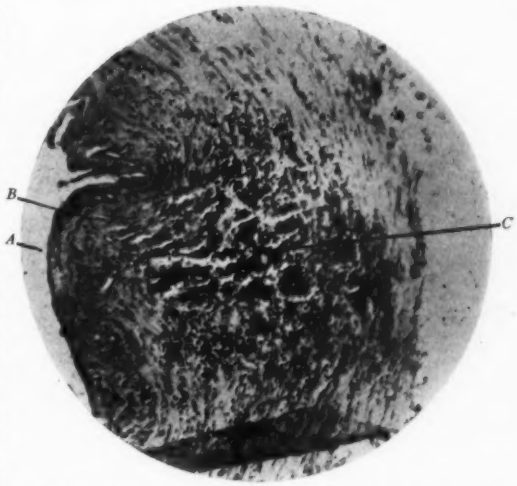

Fig. 5. Abscess in the muscularis *C*., opposite the site of rupture. *A*., lumen; *B*., internal elastica. Note the bulging of the arterial wall toward the lumen.

unknown, which was controlled by packing. On the sixteenth day, there was a second severe hæmorrhage, source unknown, which was controlled with difficulty by packing. On the twenty-third day there was a moderate hæmorrhage, probably from the femoral vein, which was controlled by ligation. On the thirty-third day there was a slight hæmorrhage from region of the vessels, which was controlled by packing. On the thirty-fourth day, in the morning there was a severe hæmorrhage, from the external circumflex artery (?), which was controlled by ligation. In the afternoon of the same day there was a moderate hæmorrhage, source unknown, which was controlled by religation of the femoral artery. The infection continued in the region of the vessels. On the fiftieth day there was a moderate hæmorrhage from a branch of the profunda femoris (?) which was controlled by ligation. On the seventy-seventh day there was a moderate hæmorrhage, source unknown, which was controlled by packing; on the seventy-ninth day there was a slight hæmorrhage controlled by packing. On the eightieth day there were several hæmorrhages probably from the profunda femoris (?), which were controlled by ligation. On the eighty-fourth day there was a hæmorrhage from the femoral artery. The external iliac artery was ligated. The result was satisfactory and the patient was evacuated five weeks later.

CASE 6. Grossly infected fracture of tibia and fibula. The patient was admitted on the second day. The leg was amputated at the lower portion of the thigh, and the stump became infected. On the sixth day there was a moderate hæmorrhage, from a small branch of the femoral artery. The artery was ligated at the stump. The stump cleaned up slowly,

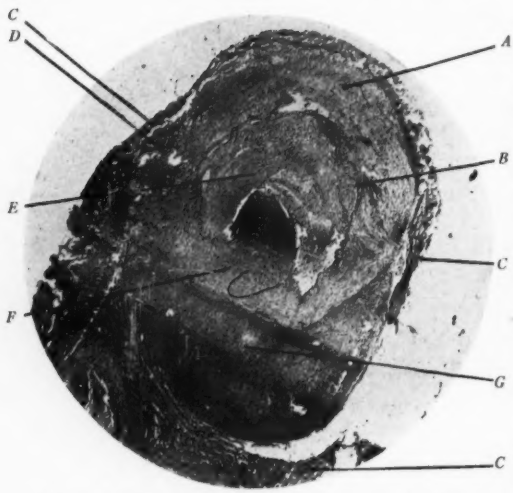

Fig. 6. Cross section of ruptured artery showing attempt at repair and false aneurism. *A.*, Arterial wall; *B.*, elastica and intima; *C., C., C.*, adventitia, the gap being an artefact; *D.*, the arterial wall densely infiltrated with red blood-cells; *E.*, thrombus occupying lumen; *F.*, granulation tissue bridging arterial gap and bulging into lumen; *G.*, crescentic blood clot under adventitia and dissecting into arterial wall at *D.*

and the patient was evacuated on the twenty-sixth day.

CASE 7. Severely infected fracture of lower tibia and fibula. The patient was admitted on the second day. The leg was amputated at the lower thigh and the stump became slightly infected. On the eighth day while dressing the wound there was a hæmorrhage due to rupture in the femoral artery. The artery was ligated at the stump. On the tenth day there was a severe hæmorrhage from higher up in the femoral artery. Death occurred almost immediately.

CASE 8. Compound fracture of the leg; gas infection. The patient was admitted to the hospital on the second day. The leg was amputated at the lower thigh and the stump became slightly infected. On the eighth day there was a brisk hæmorrhage from a rupture in the femoral artery above the ligature. The vessel was ligated in the wound. On the tenth day, there was a profuse hæmorrhage from a rupture in the femoral artery. The patient died soon after and postmortem examination showed purulent thrombosis of the femoral vein extending into the common iliac.

CASE 9. Compound fracture of the upper third of the femur, severely infected. The patient was admitted on the second day. The wound was excised but the infection continued. On the fourteenth day amputation was done but the stump became infected. On the twenty-first day, there was a very profuse hæmorrhage due to rupture in the femoral artery above the ligature. The patient died the same day.

CASE 10. Severely infected compound fracture of the femur. The patient was admitted on the second day. Amputation was done but the stump became infected. On the thirteenth day there was a sharp hæmorrhage, from the muscular branch of the femoral artery. The artery was ligated and the result was satisfactory.

CASE 11. Compound fracture of leg; gas infection. The patient was admitted on the third day. The wound was excised, but sepsis continued. On the fourth day the leg was amputated at the lower thigh and the stump became infected. On the twelfth day there was a profuse hæmorrhage, from a muscular branch of the femoral artery. The artery was dissected free and ligated in healthy area. The result was satisfactory.

POPLITEAL ARTERY

CASE 12. Grossly infected wound of popliteal region. The patient was admitted on the fourth day. The incision and resection of the torn popliteal artery were done and the patient at first improved but the infection continued. On the twenty-second day there was a severe hæmorrhage from rupture in the popliteal artery above the level of the wound. There was a purulent tract along the vessels. The leg was amputated at the lower thigh with satisfactory result.

CASE 13. Compound fracture at lower third of femur. The patient was admitted on the second day. The wound was incised but the result was not satisfactory. On the fifteenth day there was a very active hæmorrhage from a defect in the popliteal artery. A satisfactory recovery followed amputation.

CASE 14. Slightly infected wound of outer popliteal region. The patient was admitted on the second day. Incision of the wound produced unsatisfactory results. On the fifth day the infected area of the inner thigh was incised and a foreign body removed. From the sixth to the eleventh day there were several slight hæmorrhages the source of which was not known, but they ceased spontaneously. On the twelfth day there was a severe hæmorrhage from a ruptured popliteal artery. The wound was packed but the patient died almost immediately.

CASE 15. Infected wound of lower thigh. The patient was admitted on the fourth day. The Carrel-Dakin treatment was administered but the infection continued. On the fourteenth day there was a profuse hæmorrhage, from rupture in the popliteal artery with infection along the vessels. The hæmorrhage was controlled by resection of the artery by surgical approach. On the sixteenth day the leg was amputated for beginning gangrene. On the twenty-first day the femoral artery was ligated for suppurative phlebitis. Death on the thirty-sixth day. Postmortem examination showed purulent phlebitis of femoral vein extending into vena cava and pyæmic foci.

GLUTEAL ARTERY

CASE 16. Infected wounds of spinal cord and buttock. The patient was admitted on second day. The wounds were incised and foreign body removed, followed by transient improvement. On the fifth day there was a slight hæmorrhage from buttock, due to rupture of the gluteal artery (found at postmortem). The hæmorrhage was controlled by packing. The patient died on the ninth day from meningitis.

CASE 17. Moderately infected wound of buttock. The patient was admitted on the thirteenth day. The Carrel-Dakin treatment was administered and the condition improved. On the fifteenth day there was a severe hæmorrhage, source unknown, which was controlled by packing; on the eighteenth day there was a moderate hæmorrhage, source unknown, which was controlled by packing; on the nineteenth day there was severe hæmorrhage due to rupture of the gluteal artery. The vessel was ligated in the wound but the patient died the same day. Postmortem examination showed infection localized to the wound.

CASE 18. Slightly infected wound of buttock. The patient was admitted on the third day. Carrel-Dakin treatment was administered but the result was unsatisfactory and the patient continued to run a septic temperature. On the fifth day there was a moderate hæmorrhage from rupture of the gluteal artery. The artery was resected in the wound. The sepsis continued but the wound improved. Death occurred on the twelfth day. Postmortem examination showed pus foci in the wound and lungs.

CASE 19. Infected wound of buttock. The patient was admitted on the second day. Carrel-Dakin treatment was administered but the result was unsatisfactory. Suture of wound on the thirteenth day. The patient still ran a septic temperature and the blood culture was positive. On the twenty-third day, the wound was incised and foreign body removed but the sepsis continued. On the forty-third day a deep abscess was incised. On the forty-seventh day, there was a profuse hæmorrhage from rupture of the superior gluteal artery. Ligation at the sacrosciatic notch gave a satisfactory result.

CASE 20. Flat infected wound of thigh. The patient was admitted on the seventh day. The wound was dressed. On the fourteenth day there was a slight superficial hæmorrhage. The wound was packed and there was no recurrence.

PERFORATING AND OTHER ARTERIAL BRANCHES

CASE 21. Apparently clean wound, outer thigh. The patient was admitted on the fifth day. The dressings produced apparently satisfactory results. On the eighth day there was a very slight hæmorrhage from an infection deep in the wound. There was a rupture of the superior perforating artery beyond the apex of the wound. The artery was ligated as well as the profunda femoris by surgical approach. The result was satisfactory.

CASE 22. Infected wound of the popliteal region. The patient was admitted on the fourth day. Dressings were applied. On the eleventh day there was a brisk hæmorrhage due to rupture of the articular branch of the popliteal artery. Ligation by surgical approach with satisfactory result.

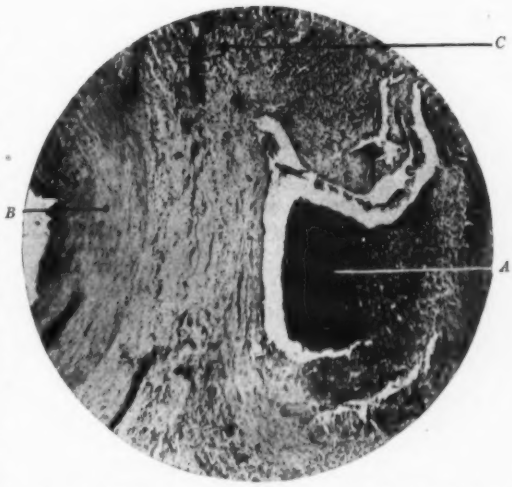

Fig. 7. Suppurative parietal thrombus *A*., in infected vein at a level at which the artery, *B*., only shows œdema of the muscularis. Infected granulation tissue, *C*., in which the vessels are embedded.

CASE 23. Grossly infected wound of upper posterior thigh. The patient was admitted on the second day. The wound was incised and much pus evacuated. On the fourteenth day there was an active oozing hæmorrhage, source unknown, which was controlled by packing. On the fifteenth day, there was an active oozing hæmorrhage, source unknown, which was controlled by packing. The patient was evacuated on the twenty-second day.

CASE 24. Infected wound of upper posterior thigh. The patient was admitted on the second day. Incision of wound on fourth day but the infection continued. On the ninth day large blood clots appeared, the source of which was unknown. The wound was packed and there was no recurrence until evacuation on the fourteenth day.

CASE 25. Superficial infected wound of buttock. The patient was admitted on the eleventh day. Dressings were applied but did not produce satisfactory results. The wound was sutured on the twenty-first day. On the morning of the twenty-third day, there was a profuse hæmorrhage, source unknown, and the wound was packed. On the afternoon of the same day there was a less severe hæmorrhage, source unknown, which was satisfactorily controlled by packing.

ANTERIOR TIBIAL ARTERY

CASE 26. Severely infected compound fracture of fibula. The patient was admitted on the second

day. The wound was incised and the anterior tibial artery was felt beyond the roof of the tract. The incision did not give satisfactory results and the purulent discharge continued. On the fifth day there was a brisk hæmorrhage, due to rupture of the anterior tibial artery with infection along the vessel sheaths. The anterior tibial artery was resected by surgical approach; result satisfactory.

CASE 27. Infected fracture of tibia. The patient was admitted on the second day. The wound was incised but the infection continued. On the fifth day there was a very active hæmorrhage, due to rupture of the anterior tibial artery with infection along vessel sheaths. Amputation produced satisfactory results.

POSTERIOR TIBIAL ARTERY

CASE 28. Infected fracture of the tibia and fibula. The patient was admitted on the third day. Incision did not produce satisfactory results and sepsis continued. On the sixteenth day there was a brisk hæmorrhage due to rupture of the posterior tibial artery, gross infection of wound, and pus in ankle joint. The lower third of the leg was amputated. Death from sepsis occurred on the forty-third day. Postmortem examination showed a pelvic abscess about vessels and pyæmic foci.

CASE 29. Compound fracture of lower tibia. The patient was admitted on the third day. Incision and removal of bone fragments produced unsatisfactory results. On the fifth day there was a slight hæmorrhage, due to rupture of the posterior tibial artery above the site of the wound, with infection along vessel sheaths. Resection of posterior tibial vessels by surgical approach and revision of wound produced satisfactory results.

CASE 30. Severely infected compound fracture of upper tibia. The patient was admitted on the second day. An incision of the wound did not control the infection. On the fourteenth day a pus pocket was incised and the knee-joint drained, and the condition improved. On the seventeenth day there was an active hæmorrhage due to rupture of the posterior tibial artery and thrombosis of the vein. Resection of vessels by surgical approach and revision of the wound produced satisfactory results as to control of hæmorrhage and sepsis. Amputation on the thirty-eighth day for destruction of knee-joint.

DORSALIS PEDIS ARTERY

CASE 31. Infected fracture of the tarsus. The patient was admitted on the second day. The wound was incised and bone fragments removed, but the infection continued. On the sixth day an abscess was incised. On the eighth day there was a sharp hæmorrhage due to rupture of the dorsalis pedis artery. The vessels were ligated in the wound. There was no recurrence but sepsis continued, becoming less at time of evacuation on the twenty-eighth day.

BRACHIAL ARTERY

CASE 32. Compound fracture through elbow-joint. The patient was admitted on the second day. The wound was excised and sutured with unsatisfactory results. On the sixteenth day a pus pocket was incised. On the nineteenth day there was a severe hæmorrhage due to rupture of the brachial artery, remote from the wound, with purulent tract along vessels. Resection of the artery by surgical approach gave satisfactory results.

CASE 33. Infected wound of upper arm. The patient was admitted on the second day. Carrel-Dakin treatment gave unsatisfactory results. On the fourth day a subpectoral abscess was incised. On the seventh day there was a severe hæmorrhage due to rupture of the brachial artery, and the artery was ligated in the wound. On the twelfth day there was a severe hæmorrhage from the infected tract along the vessels. Ligation by surgical approach was done and there was no recurrence. Death from sepsis occurred on the fifteenth day.

MUSCULAR AND OTHER BRANCHES

CASE 34. Infected fracture of upper humerus The patient was admitted on the second day. The result of Carrel-Dakin treatment was doubtful. On the sixth day there was a severe hæmorrhage from the muscular artery in the teres minor. The artery was ligated, there was no recurrence, and the septic temperature ceased after several revisions.

CASE 35. Infected wound in anterior deltoid. The patient was admitted on the third day. Dressings did not give satisfactory results. On the sixth day the wound was incised but the condition did not improve. On the eighth day there was a moderate hæmorrhage from the muscular artery. The artery was ligated in the wound, there was no recurrence, and the patient was evacuated on the nineteenth day although the wound was still infected.

CASE 36. Infected compound fracture of the lower humerus. The patient was admitted on third day. The wound was incised and the condition improved. On the seventh day there was a moderate hæmorrhage from rupture of the external articular artery. The artery was ligated in the wound with satisfactory results.

RADIAL AND ULNAR ARTERIES AND PALMAR ARCH MISCELLANEOUS

CASE 37. Infected fracture of ulna. The patient was admitted on the second day. Carrel-Dakin treatment was given and the infection was partly controlled. On the morning of the seventh day there was a slight hæmorrhage, origin unknown, which was controlled by packing. On the afternoon of the same day there was a profuse hæmorrhage due to rupture of the ulnar artery. The artery was ligated in the wound and the result was satisfactory.

CASE 38. Infected fracture of lower humerus. The patient was admitted on the third day. Carrel-Dakin treatment produced improvement in the

condition. On the seventeenth day there was a slight hæmorrhage, source unknown; also on the twenty-first day. On the twenty-ninth day there was a moderate hæmorrhage, source unknown, which was controlled by packing. There was no recurrence and the infection slowly cleared up.

CASE 39. Infected compound fracture of carpus. The patient was admitted on the third day. The wound was incised and bone fragments removed, but the condition did not improve. On the eleventh, sixteenth and seventeenth days, revisions were made but the infection continued. On the twentieth day, there was a brisk hæmorrhage from the radial artery (?), which was controlled by packing. On the twenty-second day, because of continued sepsis, the limb was amputated. The infection was found to be located along the vessel sheaths and there was a large rupture of the radial artery. The subsequent course was satisfactory.

CASE 40. Abscess of palm following abrasion. The patient was admitted on the second day. The wound was incised but the result was unsatisfactory. On the fifth day an abscess of the forearm was incised. On the eighth day there was a moderate hæmorrhage, source unknown, which was controlled by packing. On the tenth day there was a severe hæmorrhage due to rupture of the ulnar artery and infection along the vessel sheaths. Resection by surgical approach controlled the hæmorrhage. On the eleventh day there was a moderate hæmorrhage due to rupture of the radial artery, with infection along vessel sheaths. Resection of artery by surgical approach gave satisfactory results. The patient was evacuated on the twenty-sixth day.

CASE 41. Compound fracture of metacarpus. The patient was admitted on the fourteenth day. On the fifteenth day there was a severe hæmorrhage due to rupture of the deep palmar arch. Resection of the artery in the wound controlled the hæmorrhage. Later abscesses of the forearm were incised.

CASE 42. Infected compound fracture of carpus. The patient was admitted on the second day. The wound was incised and bone fragments were removed but the infection continued. On the thirteenth day the wound was revised. Infection continued and the blood cultures were positive. On the twenty-fourth day there was a brisk hæmorrhage due to rupture of the radial artery. There was a purulent tract along the vessels. Resection of the vessels by surgical approach gave satisfactory results. A subsequent resection of the carpus was done for pus foci.

CASE 43. Cellulitis of hand. The patient was admitted on the eighth day. Dressings were applied. On the ninth day there was a moderate hæmorrhage, source unknown, which was controlled by packing. There was no recurrence.

CASE 44. Abscess of palm. Patient admitted on third day. Incision of wound produced improvement. On the seventh day there was a moderate hæmorrhage, origin unknown, which was controlled by packing. There was no recurrence.

CASE 45. Infected wound of lumbar region. The patient was admitted on the fourth day. Incision of wound produced improvement. On the eighth day there was a moderate hæmorrhage, origin unknown, which was relieved by packing. Recovery satisfactory.

TRANSPLANTATION OF BONE FOR DEFECTS OF THE HEAD AND NECK OF THE FEMUR[1]

By CHARLES DAVISON, A.M., M.D., F.A.C.S., Chicago

AUTOPLASTIC transplantation of bone is of value in three types of defects of the head and neck of the femur, but in all cases the patient must be vigorous enough to withstand the operation, and young enough, as an economic possibility, to warrant the attending discomforts and dangers of the procedure and the expense of time and effort required for a successful issue.

I. Recent fracture of the neck of the femur without impaction may be repaired by grafting a segment of fibula across the line of fracture (Fig. 1). To obtain ideal results the repair should be performed early before the vitality of the capital fragment has been disturbed by lessening of its blood supply. Under favorable conditions the union of the fracture resembles healing of wounds by primary intention and without doubt the capital fragment retains its integrity and persists as a vital portion of the femur.

Case 1. B. A., male, postal clerk, aged 38, sustained an unimpacted fracture of the neck of the left femur on January 21, 1917 (Fig. 2). Transplantation of a segment of fibula across the line of fracture was performed as soon as the routine examination and preparation had been completed. A roentgenogram taken three months after operation shows the transplant grafted to both fragments with bony union of the fracture (Fig. 3). Three months later he returned to his occupation as mail distributor, which required standing and walking from eight to eleven hours daily. Positional photographs taken when he returned to work show that he could stand erect with both feet together on the floor in the normal voluntary position of rotation of the injured extremity (Fig. 5); in normal external rotation (Fig. 6); nearly normal abduction (Fig. 7); and with good flexion of the thigh on the pelvis (Figs. 8 and 9). He could at this time balance himself supporting his entire weight upon the toes of the injured extremity (Fig. 10).

A roentgenogram taken two years after operation shows bony union of the fracture with substantial callus, especially between the upper part of the neck and the trochanter. The articular surfaces of the head of the femur and the acetabulum are free from callus (Fig. 4). The roetgenogram of the caput femoris is clear. Its outline is sharp and distinct, indicating healthy living bone. The early grafting of the fragments to the transplant and to each other has preserved the vitality of the capital fragment without necessity of regeneration of the bone.

II. Ununited fracture of the neck of the femur with diminished vitality of the capital fragment may be repaired by transplanting a segment of fibula across the non-union (Fig. 1). Under favorable conditions the transplant grafts to the lower fragment in a manner similar to that in recent fractures. In the capital fragment the process is different. It simulates the healing of wounds by granulation. There is a stimulation of osteogenesis by the transplant with projection of new bone cells into the devitalized fragment which acts only as a frame-work for the deposition of new bone. The old bone is gradually absorbed as it is replaced by new bone. Under the stimulus of the transplant, new bone is deposited in and around the area of the non-

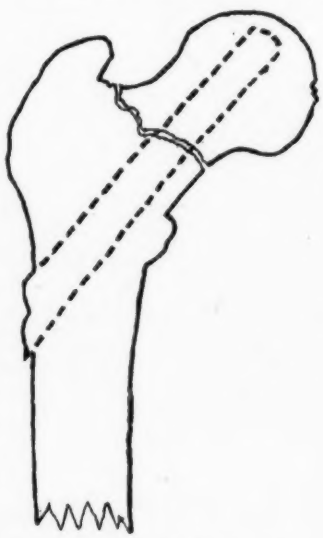

Fig. 1. Diagram of transplantation of segment of fibula across a fracture of the neck of the femur at an angle of 135° with the shaft of the femur.

[1] Read before the Chicago Surgical Society, April 4, 1919. (For discussion see p. 217.)

Fig. 2

Fig. 3

Fig. 4

Fig. 2. Case 1. Roentgenogram of recent fracture of the neck of left femur.

Fig. 3. Case 1. Roentgenogram of autoplastic repair of recent fracture of neck of femur three months after operation, showing the transplant grafted into position with osseous union of the fracture.

Fig. 4. Case 1. Roentgenogram, two years after operation, showing bony union of the fracture with substantial callus between the upper part of the neck and the trochanter.

union, until the old fracture is obliterated. Later both the transplant and the new bone are absorbed and modified until there is compensation between elasticity, strength, and function.

CASE 2. F. M. male, lather, aged 36, presented himself with an ununited fracture of the neck of

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 5. Case 1. Photograph, six months after operation, showing both feet of the patient together in normal rotation.

Fig. 6. Case 1. Photograph, six months after operation, showing normal external rotation of the injured extremity.

Fig. 7. Case 1. Photograph, six months after operation, showing nearly normal abduction of the injured extremity.

Fig. 8. Case 1. Photograph, six months after operation, showing the amount of flexion of the thigh upon the pelvis.

Fig. 9. Case 1. Photograph six months after operation, showing the amount of flexion of the thigh upon the pelvis.

Fig. 10. Case 1. Photograph, six months after operation, showing patient supporting his entire weight upon the toes of the injured extremity.

the left femur of eighteen months' duration. He was suffering severe pain and was unable to walk without crutches. He had received industrial insurance for a permanent disability. A roentgenogram revealed an ununited fracture of the neck of the left femur. The upper fragment was mottled and

Fig. 14. Case 2. Roentgenogram, four years after operation, showing an apparently complete replacement of the capital fragment by new bone, with advanced absorption of that part of the transplant, which was within the small fragment.

Fig. 11 Fig. 12 Fig. 13

Fig. 11. Case 2. Roentgenogram of ununited fracture of the neck of left femur eighteen months after injury. Capital fragment undergoing degeneration.

Fig. 12. Case 2. Roentgenogram, six months after operation, showing bony union of the pseudarthrosis.

Fig. 13. Case 2. Roentgenogram, two years after operation, showing bony union of the old fracture and partial replacement of the capital fragment by new bone, the old bone apparently acting as a limiting frame-work, shaping the outlines of the new bone.

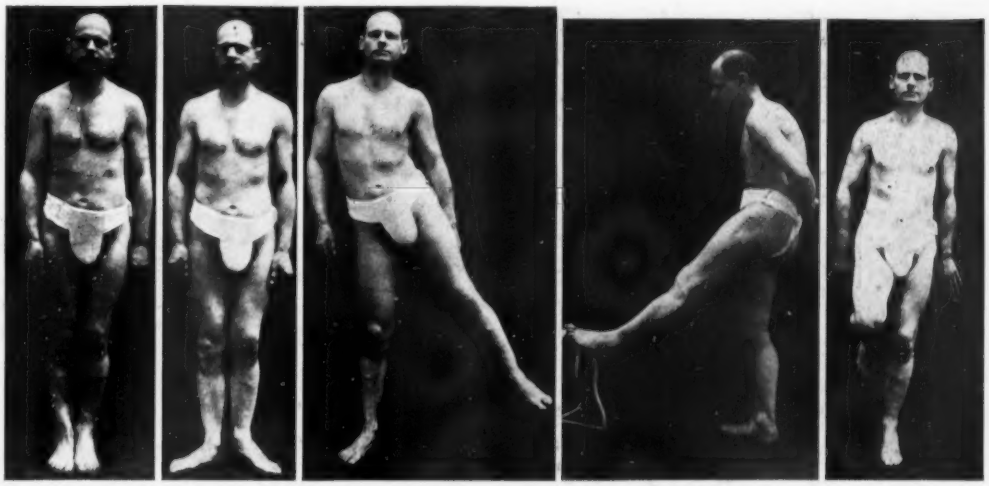

Fig. 15 Fig. 16 Fig. 17 Fig. 18 Fig. 19

Fig. 15. Case 2. Photograph, four years after operation, showing both feet together in normal rotation.

Fig. 16. Case 2. Photograph, four years after operation, showing external rotation of the injured extremity.

Fig. 17. Case 2. Photograph, four years after operation, showing abduction of the injured extremity.

Fig. 18. Case 2. Photograph, four years after operation, showing flexion of the thigh on the pelvis.

Fig. 19. Case 2. Photograph, four years after operation, showing patient supporting his entire weight upon the toes of the injured extremity.

the outline was uneven. It appeared to be undergoing degeneration (Fig. 11).

Transplantation of a segment of fibula across the pseudarthrosis was performed on January 15, 1915. After sixteen weeks of immobilization there was no motion either in the hip-joint or the pseudarthrosis.

A roentgenogram taken six months after operation shows that the transplant had been driven through the soft capital fragment into the acetabulum. It shows bony union of the pseudarthrosis, also between the transplant and shaft of the femur, and between the transplant and the pelvis (Fig. 12).

Vigorous efforts made to mobilize the hip-joint were so successful that he returned to his work as a lather, two years after operation, earning full wages.

A roentgenogram taken two years after operation shows absorption of the upper end of the transplant so that the hip-joint motion was possible. It shows the deposition of a strong mass of callus connecting the trochanter to the capital fragment above the transplant. It shows the replacement of the capital fragment by new bone, the old bone apparently acting as a limiting frame-work, shaping the outlines of the new bone. This is particularly apparent at the lower part of the capital fragment, where in the original roentgenogram (Fig. 11), there was shown beginning disintegration of the surface of that fragment. This roentgenogram shows new bone breaking through at that point and forming an irregular nodule (Fig. 13).

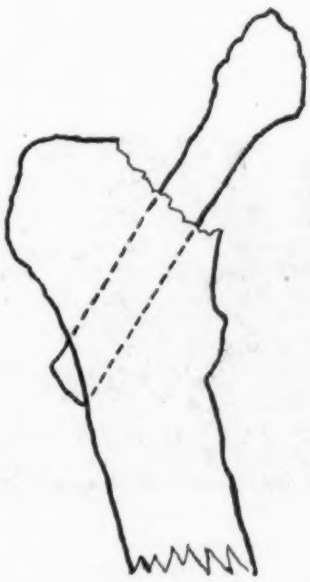

Fig. 20. Diagram illustrating method of transplantation of the upper part of fibula into the upper end of shaft of femur to remedy loss of head and neck of femur.

Fig. 21 (at left). Case 3. Roentgenogram of old fracture of neck of left femur, two years after injury, showing necrosis of the capital fragment.

Fig. 22. Case 3. Roentgenogram, one year after operation, showing the transplant grafted to the femur with the head of the fibula in the acetabulum.

A roentgenogram taken four years after operation shows an apparently complete replacement of the capital fragment by new bone with advanced absorption of that part of the transplant within the small fragment (Fig. 14).

The amount of re-establishment of function is

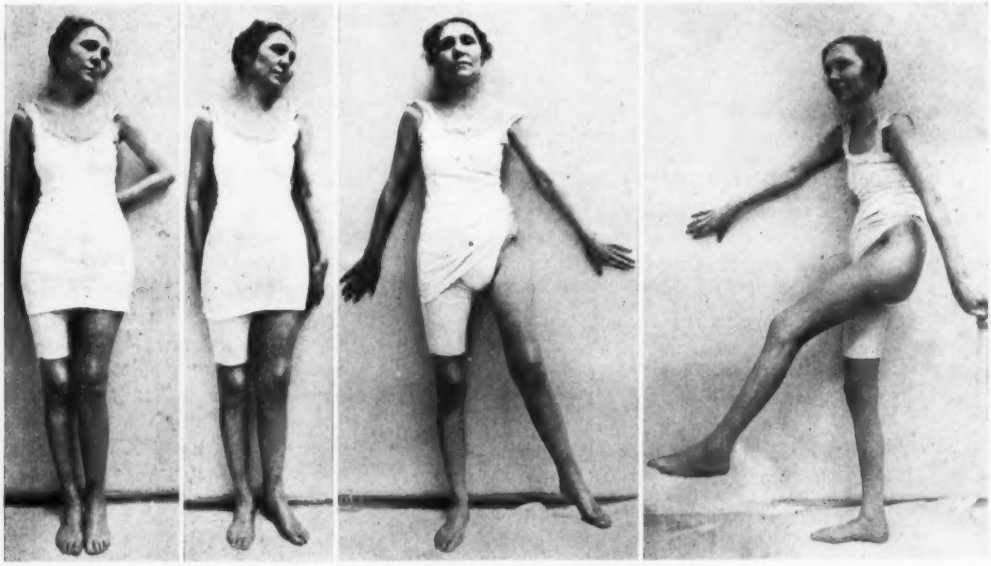

Fig. 23 Fig. 24 Fig. 25 Fig. 26

Fig. 23. Case 3. Photograph, one year after operation, showing normal voluntary position of rotation of the injured extremity.

Fig. 24. Case 3. Photograph, one year after operation, showing amount of voluntary external rotation of the injured extremity.

Fig. 25. Case 3. Photograph, one year after operation, showing the amount of abduction.

Fig. 26. Case 3. Photograph, one year after operation, showing amount of flexion of the thigh upon the pelvis.

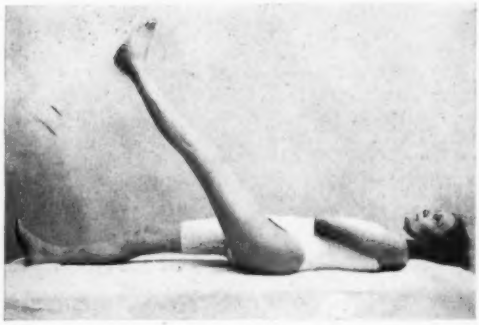

Fig. 27. Case 3. Photograph, one year after operation, showing amount of flexion of the thigh upon the pelvis.

illustrated by positional photographs taken four years after operation. He can stand erect with both feet together on the floor in the normal voluntary position of rotation of the injured extremity (Fig. 15) and in normal external rotation (Fig. 16). He has fair abduction (Fig. 17) and fair flexion of the thigh on the pelvis (Fig. 18). He can balance himself on the toes of the injured extremity (Fig. 19). He is now working as a stock-man in a wholesale sponge house, earning a respectable living and supporting a family.

III. The head of the femur, destroyed by injury or disease, may be replaced and fair function re-established by transplantation of the head and upper part of the fibula into the upper end of the shaft of the femur in such a manner that the articular surface of the head of the fibula will articulate with

Fig. 28. Case 3. Roentgenogram, two years after operation, showing hypertrophy of that part of the transplant between the femur and the acetabulum.

Fig. 29

Fig. 30

Fig. 31

Fig. 29. Case 3. Photograph, two years after operation, showing flexion of the thigh upon the pelvis.

Fig. 30. Case 3. Photograph, one year after operation, showing combined flexion and adduction.

Fig. 31. Case 3. Photograph, two years after operation, showing the patient tying shoe-lace on the injured extremity.

the acetabulum (Fig. 20). Under favorable conditions the transplant will graft to the shaft of the femur. The part of the transplant which replaces the head and neck of the femur, will hypertrophy until its size and strength are sufficient to meet the functional demands made upon the hip-joint in walking.

CASE 3. C. K., female, aged 50, presented herself with the history of an injury to the hip two years previously. She was complaining of great pain and was walking with the aid of crutches.

A roentgenogram taken at this time revealed an old fracture of the neck of the femur, with necrosis of the capital fragment (Fig. 21). Transplantation of the upper end of the fibula into the upper end of the femur was performed on April 15, 1916. Immobilization by a body plaster-of-Paris cast was maintained for seven months. This was followed by vigorous passive exercise, continued until walking was permitted. A roentgenogram taken one year after operation shows the transplant grafted to the femur with the head (fibula) of the transplant in good position in the acetabulum (Fig. 22).

One year after operation the patient could stand erect with both feet together on the floor in the normal voluntary position of rotation of the injured extremity (Fig. 23) and with a fair degree of voluntary external rotation (Fig. 24). She had a fair degree of abduction (Fig. 25) and nearly one-half of the normal voluntary flexion of the thigh upon the pelvis (Figs. 26 and 27). She was not permitted to walk without support for two years after operation.

A roentgenogram taken two years after operation shows the transplant in position in the acetabulum; that the part of the transplant within the shaft of the femur has persisted without either absorption or hypertrophy; that the part of the transplant between the femur and the acetabulum has markedly increased in size; that a strong brace of new bone has been deposited in the angle between the upper end of the femur and the transplant (Fig. 28).

Two years after operation she could walk; she could go up and down stairs; she could flex the thigh sufficiently to cross the normal thigh while sitting (Fig. 29); she could tie the shoe-laces on the foot of the injured extremity while standing (Fig. 31).

NOTE ON THE RECURRENCE OF EXOPHTHALMIC GOITER AFTER THYROIDECTOMY

BY H. G. SLOAN, M.D., F.A.C.S., CLEVELAND, OHIO
Captain, Medical Corps, U. S. A.

THE recurrence of thyroid enlargement with the characteristic symptoms of exophthalmic goiter in a small percentage of cases after the primary removal of from two-thirds to four-fifths of the gland shows that the etiological factor that caused the original growth must still be active.

A study of the case histories of patients suffering such recurrences has led the writer to believe that in many instances, if not always, the exciting cause of exophthalmic goiter and of its recurrence will be found to be an infection — usually focal in character — which must be eradicated before cure is possible.

The low resistance of patients with exophthalmic goiter to pyogenic infection is well recognized. Their systemic reaction to an acute attack of influenza or tonsillitis, for example, is far in excess of the reaction in a normal individual.

In those cases which are clinically cured after the primary operation, immunity to the focal infection has resulted from the lessening of the intoxication by the partial removal of the thyroid and by the postoperative rest and gain in weight. Certain cases, however, do not secure a permanent immunity, though they may gain in weight and the extreme symptoms are relieved. In these a persistent mild tachycardia and pyknocardia with symptoms of lack of nervous stability bear witness to the continued presence of some exciting factor. In some of these cases, immunity may be secured by the removal of more of the gland. In patients from twenty to fifty years of age, it is well to remove four-fifths of the gland; while in older patients — from fifty to seventy years of age — two-thirds is usually sufficient, since the activity of the thyroid diminishes with advancing age.

When the removal of the maximum amount

of the gland does not cure, then the exciting cause must be sought and removed as otherwise any existing focal infection will continue to stimulate the remainder of the gland.

In some cases in which tachycardia is a marked feature, rather than the so-called pyknocardia — the forcible, heaving throb, which is due to the adrenal component in exophthalmic goiter—the primary operation has been the result of a faulty diagnosis. The principal etiological factor in these cases is tuberculosis or intestinal stasis. Such patients can only be harmed by further surgery.

This forcible heart beat under nervous stress is the most reliable guide in the differential diagnosis of exophthalmic goiter.

During the last twelve months we have observed five cases from our own and other clinics which have been cured of their recurrent symptoms by the eradication of focal infections. Our observations on one of these cases in particular crystallized the author's ideas on the rôle of infection in the etiology of exophthalmic goiter.

Two years previously this patient had had a double ligation followed by the removal of four-fifths of the thyroid. He returned to almost a normal condition, except that he never fully regained his nervous equilibrium and remained a little underweight. He consulted us again because he was losing weight — he had lost eight pounds in the preceding two months. That his condition was due to a recurrence of the disease was evidenced by the vascularity of his skin — the so-called "goiter blush," the forcible and rapid heart-beat, 130, the tremors and the thrill felt over the superior vessel supplying the remnant of the thyroid, which was beginning to hypertrophy and was tender to pressure.

Examination at first revealed nothing which could account for the recurrence, though at either angle of the jaw where the tonsillar lymphatics drain, slightly enlarged cervical glands could be palpated. Nothing else indicated any pathological condition in the tonsils which were of the buried type.

Suspecting, therefore, that the strain of his law practice must be accountable for his condition, the patient was advised to take a trip to California. He returned in two months showing no sign of improvement. Just at this time, however, he had a severe attack of tonsillitis and this gave us the clue. Two weeks after tonsillectomy he felt more tranquil, was less excitable under stress. In two months he had regained his lost weight; his pulse rate had become normal; and the thrill and tenderness had disappeared from the thyroid remnant which had returned to its normal size.

Four cases have had a similar history and have shown equally satisfactory results after the removal of the focus of infection. Two other cases developed acute articular rheumatism after thyroidectomy before the tonsils were removed.

These observations on the relation of chronic infection to exophthalmic goiter have altered the author's method of procedure in primary severe cases. *Focal infections are eradicated first*, if possible, if not, then as soon as possible after the ligation or lobectomy, thus attacking the disease at its origin. In our examination of the body for foci of chronic infection we have most frequently been able to locate the trouble in the nasopharynx and mouth. Thus a history of recurrent sore throat with the presence of enlarged deep cervical glands is considered sufficient evidence to justify a tonsillectomy, even though the tonsils may look normal when the anterior pillar has been drawn aside in order to make the patient gag.

The condition of the teeth invites the closest scrutiny. If the presence of a root abscess is revealed by the X-ray, the tooth should be extracted. Temporizing with pyorrhœa invites disappointment. Extraction of the involved teeth is the only sure means of eradicating the trouble. The exposure to the X-ray of infected sinuses that resist all other methods of treatment has given very good results.

The author has found that even fulminating cases of exophthalmic goiter will stand tonsillectomy under anæsthesia better than one would suppose.

Several days after the eradication of the focus of infection, the superior thyroid arteries are ligated, and the patient is then sent home to carry out a carefully planned dietetic régimen with complete rest for two or three months before the thyroidectomy.

VESICAL DIVERTICULUM

A Clinical Analysis of 21 Cases

By FRANK HINMAN, M.D., F.A.C.S., San Francisco

DIVERTICULUM of the bladder has been long regarded by the general medical profession as a rare and unimportant anomaly, of little significance unless complicated by stone or infection, and in itself of no surgical importance. During the last decade interest in the condition has grown and numerous contributions have been written by eminent urologists and surgeons. Since it has no distinctive symptomatology, a definite clinical recognition is impossible without the use of the cystoscope or cystogram, and undoubtedly heretofore many cases have been overlooked or wrongly diagnosed.

INCIDENCE AND DIAGNOSIS

The fact that in less than four years 21 cases of diverticulum have occurred in the writer's practice indicates that the condition is by no means rare. There were two women in the series which is unusual.[1] The ages varied from 37 to 77 with an average of 56 years. There were only three cases under 50.

The cystoscope and X-ray have been found essential in making an absolute diagnosis. The cystoscopic study should be systematic and the method advocated by Young, or as illustrated by the chart (Fig. 27) insures thoroughness. A careful cystoscopic search may fail to discover the orifice of the diverticulum;[2] and the determination of the position of the diverticulum by the necessary interpretation of the cystoscopic pictures is often faulty. An estimation of the size of the pouch is difficult, even when insertion of the cystoscope into the pouch is possible, and the size and character of the orifice is unreliable as an indication.

For the above reasons the importance of the cystogram is universally recognized, but no previous writer has emphasized the importance of making contrast cystograms. The following technique is used: After the bladder has been filled by the gravity method and a plain cystogram taken, the injection solution is drained off and the bladder immediately refilled with air by injection with a double cautery bulb through the urethral catheter. The second X-ray plate, the contrast cystogram, is now taken. The air-filled bladder stands out in marked contrast to the pouches which have not had time nor opportunity to empty themselves of the X-ray solution (Figs. 1 and 2). In several cases pouches that were indefinite or not shown at all in the simple cystogram were beautifully demonstrated by the contrast method (Figs. 23 and 24), and in a few cases a supposed diverticulum with the plain cystogram was disproved by the contrast cystogram (Fig. 26.) Furthermore, the contrast method will usually give a fairly accurate record of the number and relative size of pouches. It is the exception for the diverticulum not to remain filled after bladder drainage, nevertheless, failure to get a contrast picture is not proof of the absence of a diverticulum.

Consequently, neither cystoscopy nor cystography alone is sufficient, but when cystoscopy, plain cystography and contrast cystography are properly used in conjunction they establish a definite diagnosis.[3]

POSITION AND STRUCTURE OF DIVERTICULA

In the 17 operative cases in which definite confirmation of the presence, number and position was made by direct examination, there was a single diverticulum in 11 and multiple diverticula in the other 6; two being present four times, and three and four once each (Table 1). The single sacculation was located in the neighborhood of the left ureter seven times, and near the right ureter

[1] Among the total number reported since 1906, only one was in the female, all of Judd's 44 cases were men.

[2] In Case 9 the distended diverticulum rendered the orifice inaccessible to cystoscopic view, and in Case 15 the vesical tumor and hæmorrhage obscured the orifice of the diverticulum.

[3] The coiling of an X-ray catheter into the diverticulum through its orifice is also occasionally useful.

four times. In 3 cases with two pouches there was one near each ureter and in the fourth case both diverticula were near the right ureter, but there was a deep cellule near the opposite ureter in this case. In the case with three pouches there was one near each ureter and a third opened at the base some few centimeters above the interureteral ridge. The one case (Case 5) with four diverticula is most remarkable, three being multiloculated with two orifices, one of which opened above and the other below the right ureteral orifice, and the fourth diverticulum had a huge orifice which swallowed the left ureteral meatus and ridge.

Although there may be considerable error in the cystoscopic localization of diverticula, in the unoperative series of four cases three apparently have a single diverticulum, the opening of two being above the right ureter and near the left ureter in the third. In one case (Case 21) multiple orifices were seen, apparently one each near the two ureters, and several openings of deep cellules or pouches in the base.

It is a striking fact that in not a single one of these 21 cases was the region of the ureters uninvolved. In a few instances the orifice was located several centimeters beyond the ureteral papilla (the greatest distance was about 4 centimeters which is relatively close in view of the marked bladder dilatation), but it was always definitely to the right or left and in the immediate neighborhood of the respective ureteral orifice. The mouth of the diverticulum was found located definitely in the base only when multiple pouches were present.

A rather significant fact not heretofore emphasized is the appearance and location of deep cellules (Table I). In a few cases these were of such size as to be definite pouches. In the present consideration only those are indicated that at operation would admit the tip of the index finger for about 2 centimeters. Pouches of this size were demonstrated in the cystograms in seven instances. They are larger and deeper than the ordinary cellule, but at operation do not appear of sufficient size to warrant operative removal. Such a deep cellule was demonstrated near the opposite ureteral meatus in all but 2 of the 11 cases of single diverticulum. In all but one case (Case 5) of multiple diverticula, there were deep cellules at the base, one of which (Case 9) was large enough to justify removal.

TABLE I.—LOCATION OF DIVERTICULUM AND OF ASSOCIATED CELLULES

Operative Series Case No.	Diverticulum Neighborhood of			Cellules Large Neighborhood of			Dilated ureter			Illustrations	
	Right Ureter	Left Ureter	Base	Right Ureter	Left Ureter	Base	Shown in Cystogram	Right	Left	Cystogram	Contrast cystogram
1		1[1]		1			yes	yes		Fig. 1	Fig. 2
2	2–3				2		no				
3	4	5				3	no				
4		6		4–5			no				
5	7–8–9	10						yes	yes	Fig. 10	
6	11	12				6	no	yes		Fig. 14	Fig. 15
7		13								Fig. 17	
8	14				7		yes			Fig. 19	
9	15	16	17			8	no		yes	Fig. 20	
10		18		9			yes		yes		
11	19				10	11	no				
14	20				12		yes			Fig. 23	Fig. 24
15		21		13			yes				
16	X[1]										
17		22		14			no				
18	X	V		15			yes		yes		
19		X		16		17	yes				
Unoperative Series											
12	X									Fig. 26	
13	X										
20		X									
21	W	X-Y	Z	It is probable that some of these orifices open into cellules rather than diverticula; no cystogram.							

[1]Numerals indicate diverticula as determined by operation, letters, by cystoscopy and cystography alone.

All of the large diverticula were forced to dissect their way posteriorly between the rectum and prostatovesical region. This is probably the mechanical result of intra-abdominal pressure. At operation the sacs seemed to hang as by gravity from their necks so that upon distention they would force the posterior wall of the bladder upward, and when of large size would occasion marked obstruction to urination in very much the same manner as intravesical hypertrophy of the prostate itself. In those instances, in which a mass was palpable suprapubically in patients just before urination to disappear afterward, the mass was probably the full distorted bladder itself pushed up by the distended pouches underneath.

In one striking instance (Case 9) a large diverticulum, because of its deep position posteriorly and its thick infiltrated walls, was mistaken for a right lateral prostatic hypertrophy. This is excusable in view of the firm rounded mass palpable per rectum in the position of such an hypertrophy, of the intravesical bulging of the distended sac at cystoscopy, giving the impression of a huge lateral lobe and obscuring from cystoscopic view the orifice of the diverticulum, and of the irregular shadow, shown in the contrast cystogram, being wrongly interpreted as an incompletely emptied bladder (Fig. 20).

Hydro-urachus. This series is unusual in the failure to find at operation a single diverticulum opening on the anterior bladder wall. In the literature are a few reports of a pouch with its orifice at the apex in the region of the urachus. One such patient (Case P. C. 304), a girl, age 8, has come under the writer's observation, in whom, following the ligation of a spina bifida sac when 8 days old, paralysis of both legs and incontinence of urine developed. The muscular paralysis slowly disappeared, but the urinary incontinence has persisted with only partial control of the rectum. Several years ago, following catheterization, pyuria supervened. The catheter has been used by the mother almost daily since. About two weeks ago, a small mass was noted in the suprapubic region with a swelling under the umbilicus which was thought to be an abscess. Upon incision, considerable purulent urine was discharged and a urinary fistula formed. Phthalein November 1, 1916, 10 minutes, 10 per cent, 8 per cent; November 25, 10 minutes, 5 per cent, 6 per cent. Cystoscopic examination shows a markedly enlarged and trabeculated bladder with a diffuse granular inflammation. Bladder capacity over 800 cubic centimeters. Behind each ureteral orifice are several deep cellules, and others are seen posteriorly in the fundus. It was not possible to localize the patent urachus. (Cystogram was not made.) Ureteral catheterization showed bilateral pyonephrosis. At autopsy four months later a dilated and patent urachus was found.

A pouch in this region is obviously distinctly different from those formed in the neighborhood of the ureter or base. It is in fact a uro-urachus or hydro-urachus and the inclusion of such cases as vesical diverticula leads to confusion.

TABLE II.—SUMMARY OF PATHOLOGIC FINDINGS

Case Number	Diverticulum Number	Size of Diverticulum in. cm.	Thickness of wall in mm.	Illustration
1	1	11X10X10	5	Fig. 4
2	2	10X8.2X10	4	
	3	5X4.8X4	1	Fig. 5
3	4	8.5X7X6	2.8	
	5	4.2X3X3	1	Fig. 7
4	6	5X4X4	3	Fig. 9
5	7	10X7X9	1	
	8		0.9	
	9		1.5	Fig. 19
	10	11X10X13	2.5	
6	11	12X10X10	3	
	12	7X7X6	2	
7	13	6X6X4	1.5	Fig. 18
8	14	8X7.5X7	2.5	
9	15	5X5X4	6	
	16	4X3X2.5	1.5	Fig. 22
	17	3X2X2	0.25	
10	18	3X2X2	1	
11	19	4X3.7X3	1	
14	20	5X6X4	2	
15	21	4X3.5X3	2	
17	22	3X3X2	1	

The difficulty of accurate cystoscopic localization of the orifice of a diverticulum may be again referred to. In many reports in the literature the position of the orifice was determined by cystoscopy alone, no mention being made of the operative or autopsy findings. Such reports are somewhat unreliable. The apparent discrepancy between cystoscopic and operative findings is excusable. Cystoscopic pictures demand interpretation and faulty interpretation is common where subvesical pouches have distorted normal vesical outlines.

PATHOLOGY

The diverticula removed at operation varied in size from 3 by 2 by 2 to 11 by 10 by 13 centimeters or about that of a large marble to a croquet ball. The walls varied markedly in thickness for the different diverticula and usually quite markedly for the different portions of the same diverticulum. This was particularly noticeable after fixation, upon holding the diverticulum up to the light, when thin and thick areas in the wall were immediately apparent. The smaller diverticula usually had relatively thinner walls than the larger ones. The

thickness varied from 0.25 millimeters to 5 millimeters.

Histological study reveals two unexpected findings: absence of epithelial lining of the lumen (with one exception, Case 10) and of any uniform muscular wall in definite layers. The diverticula had been packed with gauze at the time of operation to facilitate removal, and it is possible that this packing and the manipulation consequent to freeing the sac wall from peritoneal and other adhesions may have resulted in marsupilization of the mucosa. It seems unlikely that this trauma should have been so universally complete.

The inside of every sac had a smooth, glistening surface, like parchment, and unlike the dull velvety appearance of healthy mucosa. In Case 7 a small fragment of dead epithelium was found at the surface; and in Case 10 a very thin layer of flattened epithelium lined the lumen, altogether different from bladder mucosa. To a varying degree, but universally, the superficial layer next the lumen showed a chronic inflammatory reaction with engorgement of blood-vessels and round-cell infiltration, polymorphonuclears being exceptionally found. This appearance simulated organizing granulation tissue on some of the surfaces.

The muscle was invariably scattered in bands interwoven with dense connective tissue, and in some of the walls the connective tissue bands outproportioned the muscle bands. The muscle bands were sometimes cut transversely, longitudinally, or obliquely, and in a few a circular and longitudinal layer was indicated, but in not one case were definite muscle layers, as found in the bladder wall, demonstrable. Even when the musculature was heaviest, it occurred as bands distributed in dense connective tissue, and commonly with no definite arrangement.

SYMPTOMATOLOGY

The clinical evidence of a vesical diverticulum is most uncertain. The condition is popularly regarded as symptomless until the advent of infection, stone formation, or some such complication. A study of this series fails to support this belief. The duration of symptoms averages 16 years, but the duration of infection, when present, averages only about 6 years, and five cases showed no evidence of present or previous infection (Table III). One case only (Case 18) was complicated by calculus formation. Undoubtedly these two complications may aggravate symptoms just as they do in any condition of prostatism but, in view of the often prolonged periods between the onset of symptoms and their advent, to say nothing of their complete absence in many cases, cannot be justly regarded as wholly responsible.

TABLE III.—CASES GROUPED WITH RESPECT TO TYPE OF PROSTATISM AND TO SHOW THE RELATION OF INITIAL SYMPTOM TO ONSET OF PYURIA

Case No.	Age	Initial Symptom	Time of onset	
			Initial Symptom	Pyuria
Contracture of Vesical Neck *13 cases*				
1	57	Frequency and difficulty	20 years	20 years
2	67	Hesitancy and difficulty, pain in bladder region	27 years	5 years
3	56	Difficulty	20 to 30	4 years
4	55	Complete retention following straddle injury	10	10
5	37	Difficulty	5 to 10	5
6	54	Pyuria	5	5
7	46	Urgency and nycturia	25 to 30	None
8	52	Frequency and difficulty, pain in left lumbar region	15	None
9	67	Frequency and difficulty	10	2
10	75	Frequency	Since youth	5 to 6 week
11	74	Acute retention	1	None
12	50	Pain in right side on bladder distention	17	None
13	45	Diminution in urinary force	1	None
Prostatic Hypertrophy, small fibrous type *4 cases*				
14	70	Difficulty and frequency	About 10 years	10 years
15	71	Acute retention as result of urethral stricture	20	1 to 2
16	55	Frequency and burning	8	few
17	62	Difficulty and frequency	2 to 3	None
Prostatic Hypertrophy, glandular type *2 cases*				
18	68	Frequency and difficulty	5 years	1 to 2
19	69	Painful and frequent urination	17	12 to 15
In Women, 2 Cases				
20	40	Frequency, pain, burning	20 to 30	20 to 30
21	56	Frequency, pain, burning	15 to 20	15 to 20

Obstruction to urination is obviously the principal factor in symptomatology. This obstruction is primarily the result of contracture of the vesical neck (Cases 1 to 13), of prostatic hypertrophy (Cases 14 to 19), of urethral stricture (Case 15) or prolonged vesical tenesmus[1]. Secondarily, the diver-

[1] Cases 20 and 21 in whom there is the probability of contracture of the vesical neck.

ticulum itself upon distention may be so situated as to obstruct further the urinary pathway, and by its presence increase residual and predispose to infection. In a few cases the ability to urinate a large quantity almost immediately after having apparently emptied the bladder (as in Case 10), or the appearance of a suprapubic mass before, to disappear after urination (as in Cases 9 and 11) have a true clinical significance. The persistence of pyuria with difficulties in urination and residual in prostatics, following prostatectomy (as in Case 9) is further clinical evidence of the presence of a diverticulum. The initial symptoms (Table III), the course of the disease and the terminal pictures might be duplicated by a study of any series of severe prostatism, and it would appear that diverticulum of the bladder is not a distinct clinical entity.

The relationship of contracture of the vesical neck to vesical diverticulum has never been emphasized. The most striking fact of this analysis is that 13 cases, which we are led by a review of the literature to believe would be universally considered as congenital types, had contractures, and in four others prostatic hypertrophy was so insignificant and so clearly of the fibrous ring type as to be rightly considered an exaggerated type of contracture. In 3 of these fibrous hypertrophy cases multiple prostatic stones were found. In only 2 of the 21 cases was glandular hypertrophy present. In none of the group associated with enlargement of the prostate were the diverticula of any considerable size. It is further significant that in the same period covered by these 21 cases of diverticulum more than 150 cases of enlarged prostates have been examined and a diverticulum found in only 6. In 2 cases of the series, both in women, a definite finding of obstruction to urination is wanting. Both of these cases give a prolonged history of repeated attacks of pyuria, and there is a reasonable doubt of the priority of the diverticulum and of the infection. With a prolonged infection a contracture of the vesical neck is not improbable, and the findings at the operation in these two cases will have an interesting bearing on this question.

The following series of 21 cases will be analyzed with reference to incidence, pathology, diagnosis and symptomatology[1].

CASE 1. Male, age 57. U. C. H. No. 10961. The patient voids every hour during the day and four to six times at night, suffering marked pain before and after urination. There is almost continuous urgency. The urine is loaded with pus. The patient has had several attacks of neisserian infection; history otherwise negative.

About 20 years ago he was treated by dilatations with cold sounds for premature ejaculations. Before this he had noted some frequency and difficulty in urination. Following these treatments he had complete and continuous incontinency for about 2 months for which he wore a urinal. Control of urination was gradually regained but the frequency and urgency persisted. There was great pain in the bladder before and after urination and the urine was continuously very cloudy. Five months ago bleeding for 2 days was first noted; two weeks later there was a second short attack of hæmaturia.

The patient shows cardiac hypertrophy with soft systolic murmur transmitted to the axilla. The Wassermann is negative. Blood pressure, 110–70. The urine is loaded with pus and organisms; no casts. Culture shows bacillus pyocyaneus. Phthalein (intralumbar) March 9, 10 minutes 22 per cent, 37 per cent. March 14, 10 minutes, 40 per cent, 25 per cent. March 16, 10 minutes, 20 per cent, 33 per cent. March 11, blood urea nitrogen, 15.1 milligrams per 100 cubic centimeters. Rectal examination: prostate is not enlarged; median furrow and notch are well marked. No sulci laterally.

Cystoscopic examination shows no intravesicle enlargement of the prostate. Bladder wall is markedly trabeculated, particularly posteriorly, and in the region of the right ureteral orifice are three well marked cellules, one of which looks like the orifice of a diverticulum. To the left about 1½ centimeters above the left ureteral orifice is the mouth of a diverticulum into which it is not possible to insert the instrument. The interureteral ridge is raised and hypertrophied, but on cystoscopic study no definite contracture of the vesical neck is noted.

Recto-urethral palpation revealed a slight thickening or bar between the shaft of the instrument and the examining finger.

X-ray study. Plain pictures of the ureters and bladder are negative. Cystogram shows a large left-sided diverticulum with a right hydro-ureter and hydronephrosis (Fig. 1). Contrast cystogram shows that one of the three cellules near the right hydro-ureter remains filled with collargol and appears as a small round pouch about 1 centimeter in diameter (Fig. 2). Conditions as found by cystoscopy cystography and operation are diagrammed in Fig. 3

[1] The interesting theoretical question of etiology and the more practical problem of treatment, on account of their close relationship to the literature and limitations of space, will be dealt with in subsequent appers.

Operation, March 20. Marked pericystitis and peridiverticulitis are present making it impossible to strip the peritoneum from the diverticulum without tearing. An attempt to reinvert the sac and remove it intravesically was unsuccessful. The sac was packed with gauze and dissected free from the ureter which was adherent to it posteriorly, but opened independently into the bladder. The small pouch near the right ureter admitted the tip of the index finger; no prostatic hypertrophy could be demonstrated. The finger could be inserted into the urethra with some difficulty and the suprapubic view gave the appearance of a moderate contracture. Specimen removed is shown in Figure 4.

Convalescence was uneventful until May 31. The suprapubic wound had completely closed on May 25. Phthalein on the 29th was 10 minutes, 25 per cent and 12 per cent, and the urine was still very purulent. The urethral catheter had been removed on May 26 and the patient had been voiding naturally for 4 days. On May 30 he ate a very hearty dinner, including blackberry pie, and was seized the next day with severe epigastric cramps. The bowels had not moved for 4 days and all enemata had been unsuccessful. On June 1 he vomited greenish colored fluid and complained of more abdominal pain. Blood urea nitrogen was 28 milligrams per 100 cubic centimeters. By June 2 there was marked abdominal distention and definite fæcal vomiting. Blood urea nitrogen, 49.4 milligrams per 100 cubic centimeters.

Operation, Dr. Saxton Pope. Fifty cubic centimeters of clear, straw-colored fluid were evacuated from the peritoneal cavity; there was a large mass of adhesions in the midline just below the umbilicus. Enterostomy: The intestine was opened the next day and about 600 cubic centimeters of greenish brown fluid escaped. On June 7 the patient had good bowel movement and his condition was much improved. On June 10 cramp-like abdominal pains recurred and there was slight abdominal distention. The bowels did not move for 4 days and vomiting began again. On June 14 urea nitrogen of the blood was 90 milligrams per 100 cubic centimeters. On June 17 a second enterostomy was performed. The portion of the intestine below the old enterostomy sac was collapsed and bleeding and the intestines above distended. The patient died on June 24. Autopsy was not performed. Death was due to chronic peritonitis, intestinal obstruction and pyelonephritis.

Case 2. Male, age 67. U. C. H. No. 11819. The patient has marked urgency, hesitancy, and dribbling. The stream is very small and there is pain in the bladder at the time of urination. There are many blood clots and purulent particles in the urine.

The patient had small-pox at 8, neisserian infection at 18 and rheumatism at 40. About 27 years ago, during an attack of rheumatism, he had his first pain in the bladder region following which hesitancy and intermittent urination soon developed. The stream became small and there was considerable burning and pain on each urination. About 5 years ago he began to pass small particles in his urine which have persisted up to the present. For the last few years there has been marked pain low in the back, intermittent in character. Blood was first noted in the urine 2 years ago and has been present off and on since.

General examination was negative. The Wassermann was negative. Blood pressure, 125–75. The urine is quite purulent and contains many red blood-cells, no casts, many bacilli and cocci. Phthalein July 24, 14–28–22; July 31, 11–36–18. Rectal examination: prostate is not enlarged; notch and furrow well marked.

Cystoscopic examination. Bladder capacity 1800 cubic centimeters. Residual 500 cubic centimeters. There is no intravesical hypertrophy. The mouths of two diverticula can be seen opening to the right of the midline above the trigone on the posterior wall. The beak of the cystoscope can be inserted into the upper one which is the larger and about 3 centimeters from the right ureter. Its walls show a pronounced inflammatory reaction but no trabeculation and no stone is seen. The lower opening is about 1.5 centimeters above the right ureter to the outer side of the one just described. The bladder wall in the region of the left ureter is trabeculated and shows marked cellule formation. Recto-urethral examination shows no thickening of the prostate and only the suggestion of a fibrous bar. The patient was taken to the X-ray room and rather unsatisfactory plain and contrast cystograms made which showed one large right-sided diverticulum.

Operation, August 4. Suprapubic extraperitoneal excision. The bladder was dissected free of the peritoneum which could be rather easily stripped back although somewhat adherent to the upper and larger of the two diverticula. The bladder was opened and the opening incision extended to the mouth of the large diverticulum, which was packed with gauze so as to facilitate its separation from its peritoneal covering. After removal of this large diverticulum, the smaller pouch could be felt extending down between the rectum and the prostate. It was packed with gauze to facilitate its dissection. The ureter was freed and did not communicate with this sac. Incision in the bladder was extended down to the mouth of the opening and the sac was removed by circular incision. Two specimens are shown in Figure 5. A large cellule easily admitting the finger tip was present near and above the left ureter.

The patient's condition after operation was good. He developed a persistent hiccough on August 8, and the abdomen became distended. Repeated enemata, cathartics, stoops and escerin hypodermatically did not relieve his bowel condition satisfactorily. The patient developed fæcal vomiting on August 11, which continued in spite of repeated stomach washings. Enterostomy operation August 12, by Dr. Pope to relieve the paralytic ileus. The

patient died that afternoon. Autopsy report: Chronic diffuse nephritis, interstitial type; acute hæmorrhagic cystitis, bilateral acute ureteritis, bilateral pyelitis, acute splenic tumor, parenchymatous and fatty degeneration of the mitral valve; hypertrophy of the heart; acute bronchopneumonia; pulmonary œdema and emphysema; chronic pulmonary tuberculosis; chronic adhesive pleuritis; intestinal obstruction (paralytic ileus).

CASE 3. Male, age 56. The patient has a suprapubic urinary fistula through which practically all the urine drains.

He has had unusually good health, although he has had neisserian infection several times.

For a great many years (25 to 30) slight difficulty in urination has been noted which was attributed to urethral stricture. Four years ago he was unable to void at all until after one hour's straining when there was slight dribbling attended with much pain and burning. For this he received sounds and dilatations during the next three months with little improvement. He then entered a hospital for one week where bladder irrigations were given. During these few months, on account of the straining, severe and painful hæmorrhoids developed. For the next three years burning, urgency, and extreme difficulty continued. During the last six months of this period he used a catheter regularly about every four hours. In October, 1915, the patient had become so weak that he was unable to care for himself and again entered a hospital and a suprapubic cystotomy was done under local anæsthesia. After six months of suprapubic drainage the patient was given a general anæsthetic and an attempt was made to close the suprapubic fistula which, however, broke open a few days later. He was in the hospital eleven months during which time and ever since practically all of his urine has drained through the suprapubic fistula.

General examination was negative. Blood pressure, 142–98. Phthalein: 10 minutes, 36–16. Urine is markedly purulent with an occasional red blood-cell; no casts, abundant bacilli. Rectal examination: Prostate is not enlarged; median furrow is shallow and the notch is well marked; surface is flat and elastic and the lateral sulci shallow.

Cystoscopic examination. No urethral strictures. It was necessary to depress the instrument considerably in order to see the bladder wall posteriorly. The bladder mucosa is rough and leathery with the appearance of a mild encrusted cystitis in small portions. The walls are markedly trabeculated and numerous cellules are present posteriorly. The mouths of two diverticula are seen; one small about 4 millimeter in diameter, just above the left ureter, and another large 1.5 centimeters in diameter to the right of the midline about 3 centimeters above the right ureteral orifice. This sac evidently ballooned out beneath the bladder wall thus pushing it up so that it is difficult to depress the instrument sufficiently to see the orifice of the diverticulum and it is not possible to insert the beak of the instrument into it. Ropy masses of pus can be seen floating out of the mouth. The prostatic orifice is slightly irregular but presents no definite sulci or intravesical projections. There is, however, a definite median bar formation.

Operation March 8. Extraperitoneal excision. Specimen shown in Figure 7. Large cellule at base. Both diverticula near the respective ureters. Conditions as found are shown in Fig. 6.

Convalescence was uneventful. The suprapubic fistula, however, closed slowly and would remain closed two to three days at a time and then reopen partially. Urination through the urethra was difficult and frequent. The patient, at his request, left the hospital with a slight suprapubic leakage.

Cystoscopic examination, October 27, showed bladder capacity 120 cubic centimeters; residual 10 cubic centimeters, with pronounced contracture of the neck. The patient was readmitted October 29. A Young's punch operation was performed under local anæsthesia, bleeding being controlled by fulgeration of the cut surface immediately after the punches were made. The suprapubic wound following this quickly closed, and by February, 1918, there was complete control of urination. No difficulty. Nycturia of 1 to 3. Bladder capacity 250 cubic centimeters with no residual and the urine practically clear. The patient was seen in January, 1919. He has complete control of urination. Nycturia, none to one; urine clear; cured.

CASE 4. Male, age 55. P. C. No. 173. Referred by Dr. A. W. Meyer, Stanford University. There is a constant desire to urinate which is accomplished only after much straining. The stream is very small and at times almost a dribble. The urine is cloudy with pus.

The patient has always had excellent health. No infectious diseases, and no history of neisserian infection.

About 10 years ago he fell astride of a pipe after which he had complete retention and was catheterized for the next 10 to 12 days. He has never voided normally since this accident. Frequency and difficulty have been gradually growing worse.

General examination was negative. Wassermann negative. The urine is purulent and shows many colon bacilli; no casts. Phthalein with a retention catheter March 14, 10 minutes. 50–10.

Rectal examination. Prostate is small and elastic and the vesical area slightly indurated. Secretion shows 80 per cent pus.

Cystoscopic examination. Bladder capacity 1100 cubic centimeters. Residual 600 cubic centimeters. No urethral strictures. There is no intravesicle prostatic hypertrophy but a very definite median bar posteriorly. To the outside of each ureteral orifice there is marked trabeculation and numerous cellules, and posteriorly in the lower part of the fundus is seen a perfectly rounded black opening about 1.5 centimeters in diameter which is so far back that it is not possible to insert the cystoscope into it.

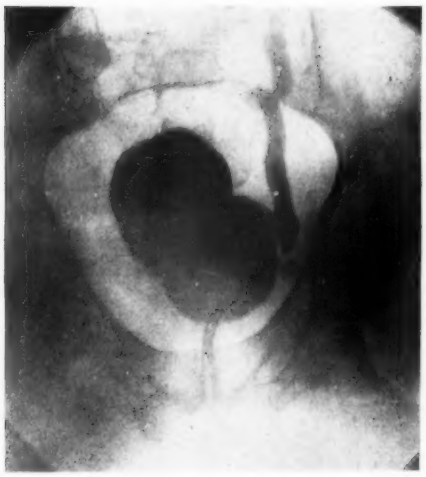

Fig. 1. Cystogram Case 1. Large diverticulum on left side. Markedly dilated and tortuous ureter on the right, with a large cellule below its opening into the bladder.

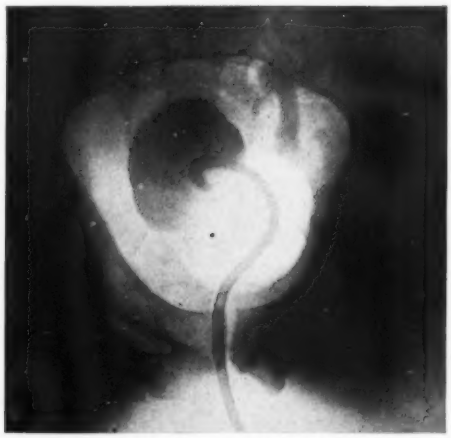

Fig. 2. Contrast cystogram, Case 1. The diverticulum, dilated ureter and large cellule have remained full of thorium nitrate and stand out in marked contrast to the air-distended bladder lying in which is seen the coiled end of the urethral catheter.

Recto-urethral examination shows a definite bar at the neck which the beak can be felt to override. Cystogram shows a large diverticulum posteriorly to the left with a small pouch in the region of the right ureter. The patient was put on preparatory treatment and residual reduced to 120 cubic centimeters.

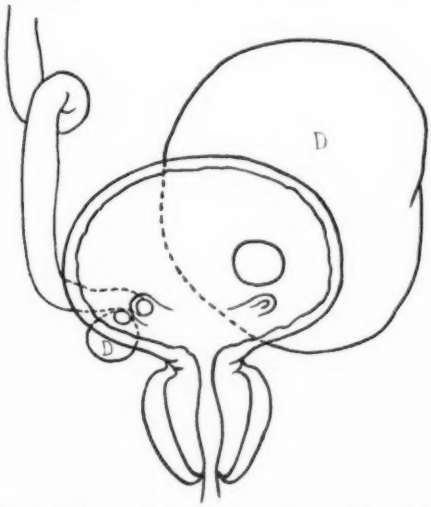

Fig. 3. Diagram of conditions in Case 1. Dilated right ureter and orifice with deep cellule below. Orifice of diverticulum above left ureteral meatus which is not dilated.

Operation, May 10. Suprapubic extraperitoneal excision. There was a marked stricture at the neck which was divided with Young's punch and bleeding controlled by direct cauterization with a Paquelin. Examination after opening the bladder showed that there were small pouches on either side near the ureteral orifices which were so shallow that it was not considered necessary to excise them. Orifice of specimen removed (shown in Fig. 9) was only

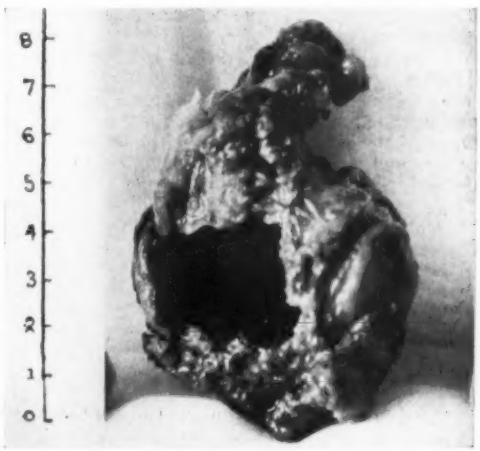

Fig. 4. Photograph of diverticulum removed in Case 1. It has been preserved in formalin and has shrunken far below its limit of distensibility (see Table II).

Fig. 5. Photograph of two diverticula removed in Case 2. Considerably shrunken after preservation in formalin (see Table II).

about 4 centimeters above the left ureter. The findings are shown in Fig. 8.

Convalescence was uneventful. On June 16, the patient returned complaining of a return in the difficulty of urination of which he had been practically free since operation. The urine was cloudy and there was 120 cubic centimeters residual. The prostate shows marked infection, 90 per cent pus, and only an occasional lecithin body. The patient was treated during August, September, and October for his prostatic infection. Residual varied from 10 to 100 cubic centimeters during this time.

Cystoscopic examination, November 17, reveals 2 small stones lying behind the trigone. Aside from the trabeculation and cellules previously noted, bladder inspection was negative except for the vesical orifice which is raised and still shows a pronounced median bar which is definitely felt on recto-urethral palpation.

Second operation, November 21: Litholapaxy. The cystoscope was inserted afterward and the bladder was seen to be free of stones. The contracture at the neck was again divided by three deep punches with Young's instrument. Convalescence was uneventful. Urine quickly became normal and quickly cleared. Prostatic infection treated during December when it had completely cleared. The patient was seen in January, 1918, and has remained perfectly well. The urine is clear; urination normal. There is no residual. Letters October 29, 1918, December 12, 1918 and February, 1919, state that the patient has remained perfectly well.

Case 5. Male, age 37. U. C. H. No. 15086. The patient has complete retention and is leading a catheter life. He has considerable pain in the right inguinal and lumbar regions. The urine is purulent. He has frequent attacks of chills and fever. His general health has been good up to the present illness. Neisserian infection denied.

About five years ago the patient noticed that the force of his urinary stream was becoming progressively diminished and this rapidly increased so that in another year it became impossible for him to urinate at all unless he lay on his right side and even then urination was painful and he always had a feeling that the bladder was full. The effort to empty the bladder was severe and as he himself describes it he would get "black and blue" in the face during the struggle. In a few months about an ounce only of urine could be voided, after extreme effort, even when lying on his right side, and it was necessary to attempt this as often as every 20 to 30 minutes. He had to give up all work. It was then that he began the use of a catheter, now over 3 years, which has been kept up 3 to 4 times daily ever since. Eighteen months ago cystotomy was performed and following this a suprapubic urinary fistula formed. An effort to close it was made 5 months later. For many months now he has suffered severe pain in the bladder, scrotum, and penis and in the right side and kidney region and has had several severe attacks of chills and fever.

General examination is negative. Wassermann negative. Blood pressure 140–85. Phthalein test, October 12, 10 minutes, 15–10; October 15, 10 minutes, 25–10. The urine is purulent with a few red blood cells; no casts; many bacteria. Rectal examination: Prostate is not enlarged, but rather broad and indurated.

Cystoscopic examination. Bladder capacity 700 cubic centimeters. Complete retention. Inspection of the vesical neck shows no prostatic hypertrophy, but a marked contracture. The bladder is trabeculated and in the region of the right ureter are 2 orifices, one above and one below the ureteral orifice. The left ureter cannot be seen and in its neighborhood is an unusually large orifice, the mouth of a third diverticulum. Cystogram shows numerous diverticula as illustrated in Figure, 10. and in drawing Fig. 11.

Recto-urethral palpation reveals a rather pronounced bar at the neck.

Operation, October 16, 1917. Suprapubic extraperitoneal excision of 4 diverticula, three of which were removed in one mass from the region of the dilated right ureter which was transplanted to the middle portion of the bladder posteriorly. The left ureter opened into the lower lip of the large diverticulum at the left and was preserved by making a flap after the method of Young. Specimens are shown in Figure 12 and a drawing to illustrate the multilocular nature of the 3 diverticula on the right side is reproduced in Figure 13. Owing to the prolonged and severe nature of the operation the vesical neck was not operated on.

Convalescence was slow and prolonged because of the right-sided pyonephrosis. December 28, phthalein, 10 minutes, 15–25. The suprapubic fistula closed and reopened frequently. February 8, Young's punch operation was performed. The patient was discharged February 17. The patient has been markedly improved since discharge, although on several occasions the suprapubic fistula has opened for one or two days with slight drainage. The urine is still purulent and the patient has had an occasional chill with night sweats always accompanied with tenderness in the right kidney

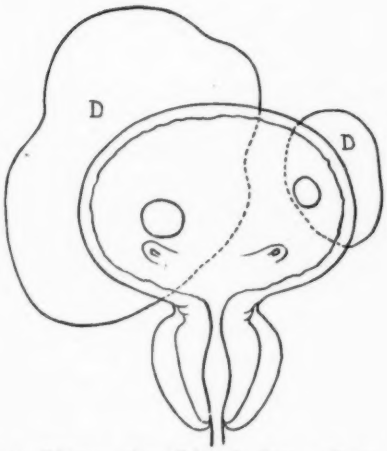

Fig. 6. Diagram of conditions in Case 3. Large diverticulum opening into the bladder just above the right ureteral meatus and smaller diverticulum with its orifice farther above, but definitely in the neighborhood of the left ureteral meatus.

Fig. 7. Photograph of the two diverticula removed in Case 3 (see Table II).

region. The bladder capacity is 140 cubic centimeter; no residual. Urination is still frequent. The patient has been at work in a machinery warehouse for several months. He was last seen March 1, 1919. He has not lost a day's work since last note. The urine has been clear for several months and he has had no chills, sweats, or fever for many months. He voids freely with complete control. Still nycturia 1 to 3. This is a most remarkable recovery of bladder function.

CASE 6. Male, age, 54. P. C. No. 558. Referred by Dr. June Harris, Sacramento, California. The patient complains of headache and dizziness, frequency and burning upon urination, pain in the lumbar region, marked pyuria and occasional hæmaturia. His health has been good except for malaria at 14 and neisserian infection at 20.

The first evidence of present trouble was noticed about 5 years ago when he was refused for insurance on account of pyuria. He had passed an examination 7 years previously. Very soon afterward he began to have headaches and frequency and burning upon urination, and these symptoms have gradually increased in severity until during the last 6 months he has voided every 20 to 30 minutes and at some periods during each 24 hours has passed blood. The patient has had pain in the lumbar region off and on for the last 10 years, and admits that he has had some difficulty on urination for many years, with infrequent periods of frequency.

General examination is negative. Wassermann is negative. Blood pressure, 148–90. Urine is very cloudy with pus; no casts; numerous red blood

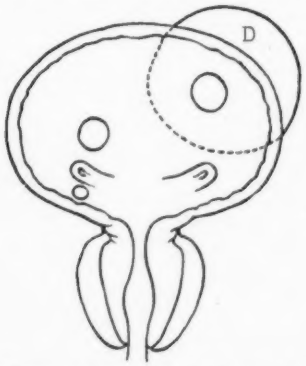

Fig. 8. Diagram of conditions in Case 4. Large diverticulum posteriorly with its orifice above the left meatus. Cellules above and below the right ureteral meatus.

Fig. 9. Photograph of diverticulum removed in Case 4. Preserved in formalin and shrunken (see Table II).

Fig. 10. Cystogram of Case 5. Shows three diverticula on the right side, 1, 2 and 3, and one very large diverticulum, 4, on the left.

cells; many streptococci and short bacilli. Phthalein December 23, 10 minutes 18–13; December 28, 10 minutes 25–15. Rectal examination: Prostate is small and indurated, furrow and notch are well marked.

Cystocopic examination. Bladder capacity, 600 cubic centimeters; residual 350 cubic centimeters. There is no intravesical prostatic hypertrophy, but a definite contracture of the neck. The orifices of two diverticula are distinctly seen one on each side above the respective ureters into neither of which could the cystoscope be inserted. The bladder posteriorly, is trabeculated with numerous cellules. The cystogram, shows 2 diverticula as illustrated in Figure 14 and contrast cystogram, Figure 15, and in diagram, Fig. 16.

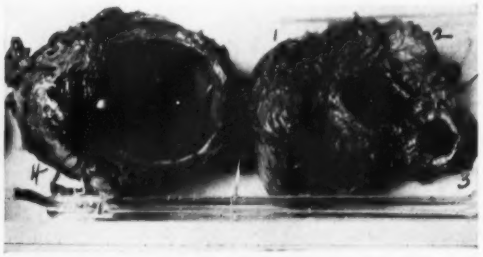

Fig. 12. Photograph of specimens removed in Case 5. The two orifices of the three fused diverticula are shown, and inside the upper border of the larger is seen the block opening with glistening rim of diverticulum 2. The ureter opens on the ridge to which the arrow points dividing the two orifices.

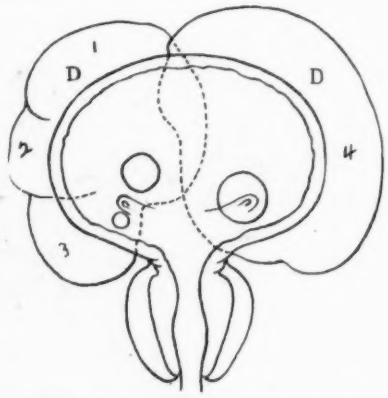

Fig. 11. Diagram of conditions in Case 5. (The diverticula on the right side have been numbered in reverse order in Fig. 10). Diverticula 1 and 2 (2 and 3, Fig. 10) were divided by a well developed septum but opened by a common orifice into the bladder above, while diverticulum 3, opened by an independent orifice below the ureteral meatus. The three were so intimately bound together that separation could be accomplished neither at the time of operation nor postoperatively by dissection. Inasmuch as the ureter passed between 2 and 3 about 4 centimeters of its vesical end had to be sacrificed and the new ureteral stump transplanted into the bladder fundus. The orifice of the diverticulum on the left side was large and about 1 centimeter inside on its inferior surface the left ureteral meatus was located. By utilizing a triangular flap of the lower wall of the orifice and diverticulum, after the method of Young, it was possible to preserve the left ureter.

Operation, January 10. Suprapubic extraperitoneal excision of 2 diverticula one on each side above and near the respective ureters. The left one was about twice the size of the one on the right. The right ureter was dilated and tortuous. The right diverticulum was removed by the inversion method of Young. There is a marked contracture at the vesical neck, which, owing to the patient's condition, was not divided.

Convalescence was slow but uneventful. The bladder had completely closed on February 4. A urethral punch operation February 9, was followed by considerable hæmorrhage, which became profuse on February 16, and was checked only after reopening suprapubically and packing with gauze. Whole blood injected intramuscularly. Blood pressure, 85–40. Patient much improved on the next day. Blood pressure, 98–60. No more bleeding and the wound was completely closed on March 20. The patient was discharged March 22.

He was seen May 9, 1918, at which time the bladder capacity was 150 cubic centimeters, residual 30 cubic centimeters. The bladder is negative cystoscopically except for trabeculation. There is no evidence of median bar or contracture. A letter

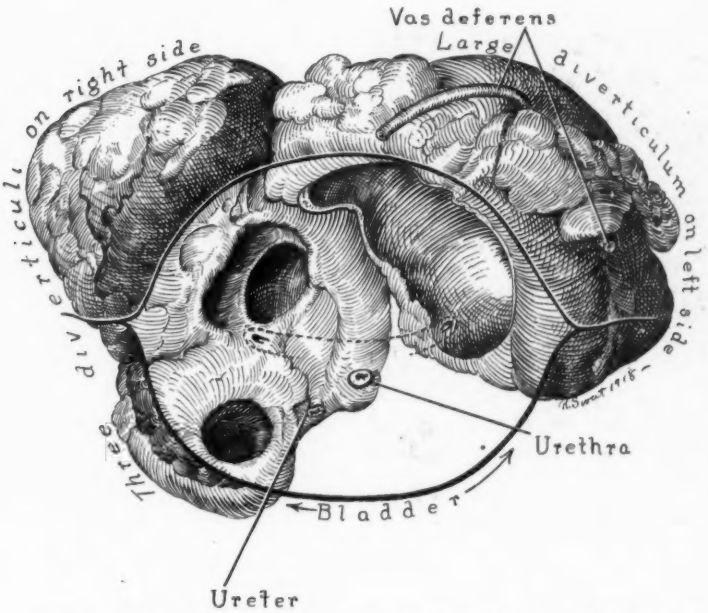

Fig. 13. Drawing of four diverticula removed in Case 5 to show relationship to ureteral orifices. The left vas deferens was sacrificed in the removal of the left sac which extended deeply posteriorly and in the attempt to free and preserve the left ureter. The cut end of the right ureter is shown hanging from the lower portion of the specimen.

from the patient in September, 1918, states that he has completely recovered, voids normally and without difficulty, and has no nycturia. The urine is clear. The patient was seen December 20, 1918, and was perfectly well. There was no nycturia. The urine was slightly cloudy; no residual. Prostatic secretion shows 80 per cent pus and diminution in lecithin.

Case 7. Male, age 46. P. C. No. 438. Referred by Dr. T. J. Cox, Sacramento, California. The patient complains of burning and urgency and pain on urination. Nycturia 5 to 10. He is very nervous, sleeps poorly, and has constant dull ache in the lumbar region radiating out to the thighs. He also had pain in the arms, legs, neck and shoulders, and suprapubic discomfort.

His general health has never been good. He has had lumbar neuralgia for years. He was operated on in 1911 for gall-bladder infection. Polypi were removed from the nose three years ago. He has had much stomach trouble. He gives a strong alcoholic history. Chancre 30 years ago. Treatment for 2 years. Neisserian infection 28 years ago and several attacks since.

The patient states that he has had slight burning and urgency with nycturia 2 to 3 all his life. There has been slight difficulty in starting stream, but never any retention or hæmaturia.

General examination negative. Repeated Wassermanns during the last 4 or 5 years have all been negative. Spinal puncture April 30, 1918, shows negative Nonne and Noguchi. No increased cell count. Spinal fluid Wassermann, negative. Blood pressure, 110–75. Phthalein, 10 minutes, 30–20. Urine shows shreds in glass 1 and a few pus cells microscopically in glass 2; faint trace of albumin. Rectal examination: prostate is slightly enlarged, uniformly indurated with definite adhesions latterally. Seminal vesicles slightly indurated with marked intravesicle thickening. Secretion shows 90 per cent pus. No lecithin; no spermatozoa.

Cystoscopic examination. Bladder capacity 460 cubic centimeters; residual 120 cubic centimeters. Inspection of the vesical neck shows no sulci or intravesicle hypertrophy. There is a slight median bar and the interureteral ridge is raised and hypertrophied. Upon the left side about 3 centimeters above the left ureter is seen the mouth of a diverticulum. There is slight trabeculation and cellule formation in the region of the right ureter.

Diagnosis. Pronounced chronic prostatoseminal vesiculitis; contracture of the vesical neck; diverticulum of the bladder. Cystogram shows a large pouch on the left side illustrated in Figure 18.

Operation, August 6. Suprapubic extraperitoneal excision. The specimen removed is shown in

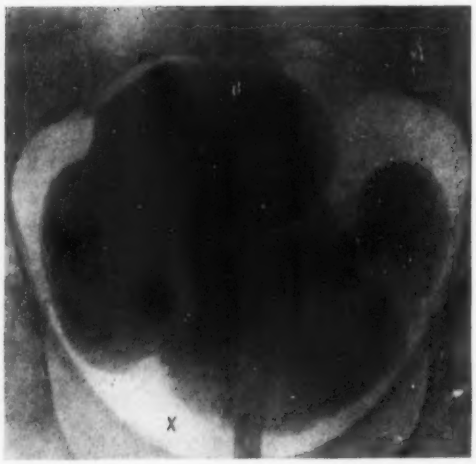

Fig. 14. Cystogram of Case 6 (compare with Fig. 15). The trabeculation and cellulation of the bladder is well shown particularly at the right lower border, *X*.

Fig. 15. Contrast Cystogram of Case 6. The two diverticula are beautifully demonstrated lying behind the "transroentgent" oval air distended bladder. No large cellules are seen.

Figure 18. The vesical neck was not operated on except for thorough dilatation. Cellules on right were too small to admit finger tip.

Convalescence was uneventful. The patient left for Calgary, B. C., shortly after leaving the hospital and subsequent examination has not been made as yet. He writes that he is much improved; that he became perfectly well but that three months ago had influenza, since which he has noted some hesitancy, frequency, and slight difficulty on urination, probably due to recontracture of vesical neck. No residual, urine clear except for shreds. Prostatic secretion 50 per cent pus.

Case 8. Male, age 51. P. C. No. 832. Referred by Lt. Commander Eyttinge, U. S. N., Mare Island Navy Hospital. The patient complains of nycturia 2 to 3. There is pain in the left lumbar region radiating to the groin. He suffers from nervousness and insomnia.

His health has always been good. Neisserian infection at 31.

In 1904, the patient fell on shipboard and was ill for 2 months with pain in the left lumbar region. In 1916, he again had a fall of 40 feet on shipboard and had a recurrence of pain in the left lumbar region which disabled him for 3 weeks. Since this last injury he has never been well, having recurrent pains in the left side. Five days ago he slipped down a ladder, landing on his left foot causing a recurrence of the left lumbar pain. There has been no particular urinary history. No difficulty or frequency.

General examination is negative. Wassermann is negative. Urine is negative. Phthalein, 10 minutes, 45–15. Ureteral catheterization, double pyelography with complete X-ray studies of kidneys and ureters negative. Wax-tip exploration negative for ureteral stone. X-rays of spine negative. Rectal examination: Prostate is not enlarged; furrow and notch are well marked. Secretion is negative.

Cystoscopic examination. The bladder capacity is 480 cubic centimeters; residual 110 cubic centimeters. No intravesicle hypertrophy. The bladder is slightly trabeculated, particularly near the ureteral orifices, with some cellule formation. About 2 centimeters above the right ureter is the orifice of a large diverticulum. Cystogram illustrated in Figure 19.

Operation, August 29. Suprapubic extraperitoneal excision of diverticulum. Deep cellule in left ureter.

Convalescence was uneventful. The bladder closed *per primam.* A letter from the patient, October 29, 1918, states that he has remained perfectly well and has had no recurrence of his lumbar pain and does not now get up at night to urinate. Examination at Mare Island Hospital a few days before discharge showed bladder capacity 400 cubic centimeters and 80 cubic centimeters residual. Examination November 17, 1918, shows 75 cubic centimeters residual and patient still complains of suprapubic discomfort and some slight difficulty in urination. Young's punch operation for contracture at neck performed at University of California Hospital January 21, 1919. The patient was seen on

March 1, at which time there was no residual; no nycturia; the urine was clear and he voided freely and normally.

CASE 9. Male, age 67. P. C., No. 858. Referred by Dr. J. N. Toner. The patient complains that he has no control of urination, he has almost constant dribbling and wears a urinal.

He had typhoid at 25, pneumonia at 55, neisserian infection at 22. Lues denied.

For several years the patient has had some frequency of urination and slight difficulty. About 2 years ago he had sudden complete retention for which he was catheterized. There was some relief for a few months when he was advised to have an operation which was done in September, 1917, through the perineum. Subsequent events lead one to suspect that no prostatic enlargement was found. The condition was not relieved but was very much aggravated; frequency every 15 to 30 minutes, with continuous urgency. For several months there has been incontinence.

On the right side, below the umbilicus, a rounded mass is palpable which disappears after catheterization; right epididymis enlarged the size of a goose-egg.

Wassermann negative. Phthalein, September 9, 10 minutes, 5–5; September 15 (after the use of a retention catheter) 10 minutes, 30–25. Urine shows abundant pus; much albumin; no sugar; no casts. Rectal examination: hæmorrhoids present. Prostate was found to be enlarged and indurated; secretion shows 50 per cent pus. The enlargement is confined to left side only and was considered to be a large left lobe overlooked at previous operation.

Cystoscopic examination. The bladder capacity was 500 cubic centimeters. There was complete retention. Large left-sided intravesicle prostatic enlargement (which operation disproved). The bladder wall is trabeculated and the orifices of numerous pouches and cellules are visible. The left ureter could not be found and apparently opened behind the intravesicle lobe (found at operation to be a distended diverticulum). Above the right ureter is the mouth of a large diverticulum. Posteriorly above the trigone are the orifices of 2 other diverticula; numerous deep cellules posteriorly, and in the region of the right ureter.

Recto-urethral examination shows apparent thickening on left side, and a definite median bar over which the beak of the instrument is felt to ride. Cystogram shows diverticula as illustrated in Figure 20, and their relationship to the bladder and ureters is illustrated in Figure 21.

Operation, August 19. Suprapubic extraperitoneal excision of 3 diverticula. The orifice of the fourth diverticulum noted on cystoscopy in the midline, posteriorly, admits the tip of the index finger for about 1.5 centimeters and was not thought sufficiently large to justify removal. The left ureter opened into the largest diverticulum on the left side and was transplanted to the mid-

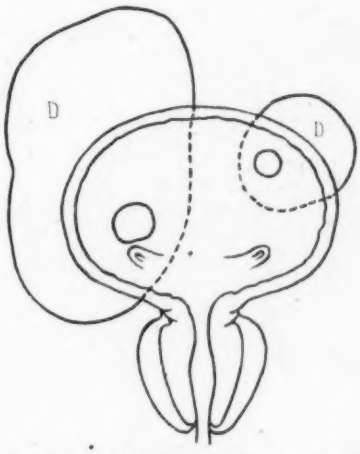

Fig. 16. Diagram of conditions in Case 6. At operation neither ureter had to be transplanted.

portion of the bladder posteriorly. The vesical neck was widely dilated and divided with a cautery. Specimens removed are shown in the photograph, Fig. 22. For the first few days following operation the patient's condition was not satisfactory. On the 25th, he developed signs of pneumonia with consolidation of the right apex and fluid at the right base which was tapped at the eighth interspace and about 10 cubic centimeters of clear straw colored fluid obtained. Since then improvement has been steady. The patient is walking about, although still in the hospital, and the suprapubic fistula is still draining. On December 1, 1918, the suprapubic fistula closed for a few days but reopened.

Second operation, February 19, 1919. The bladder capacity is 130 cubic centimeters. The patient dribbles and is unable to empty his bladder. The suprapubic fistula is still open, about half of urine draining through it. Nitrous oxide oxygen anæsthesia. The fistula was resected down to the bladder. Exploration of neck shows tight fibrous circular contracture which was divided by Young's punch *per urethram*, guided by suprapubic control. Bladder closed tightly. Coude catheter in urethra.

On March 2, the condition was satisfactory. The urethral catheter was still in place, attached to Davis suction bottle.

On March 6th, suprapubic wound was healed and has been perfectly dry for three days.

On March 12th, suprapubic wound healed. There is only partial control of urination, probably due to disturbance of external sphincter at time of prostatectomy.

CASE 10. Male, age 75. There is marked frequency with inability completely to empty the bladder; burning at beginning of urination; pyuria. The patient had a neisserian infection when 35.

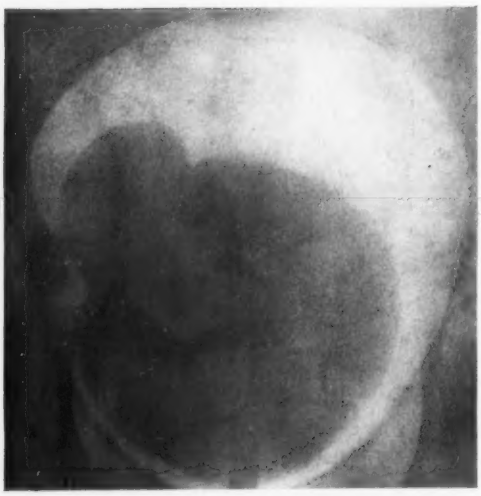

Fig. 17. Cystogram of Case 7.

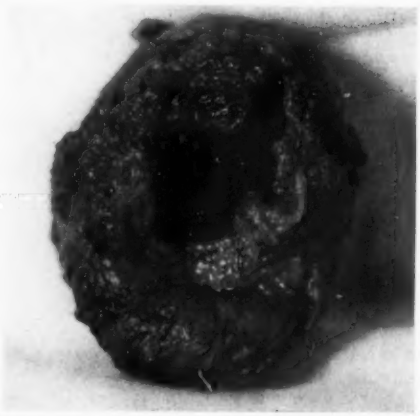

Fig. 18. Photograph of specimen removed in Case 7 (see Table II).

The patient states that he has been troubled with urinary frequency since youth and particularly during the last 20 to 25 years. Nycturia has averaged 5 to 7, amount voided each time being small. For the last six years frequency has been more marked and there has been pain at the beginning of urination with periodical attacks of marked urgency. There has never been any complete retention or hesitancy. For the last six weeks the urine has been cloudy. Blood has never been noticed in the urine. There has been no dribbling; never passed stones. His general health has been good until six weeks ago, since which time he has noted weakness.

General examination negative. Blood pressure, 105–50. Wassermann, negative. Urine shows slight trace of albumin with abundant pus and many organisms. Phthalein, 12–18 (intralumbar), 10 minutes, 15 per cent, 15 per cent. Phthalein 12–25: 10 minutes, 30 per cent, 10 per cent. Rectal examination: Prostate is small, smooth and elastic. Notch and furrow are well marked. Prostate is not fixed in position. Seminal vesicle area is negative.

Cystoscopic examination. There is shown no sulci or evidence of prostatic hypertrophy, but a pronounced contracture of the vesical neck. About 2 centimeters above the meatus of the left ureter is the mouth of a diverticulum. The bladder wall, posteriorly, is trabeculated with shallow cellules, but no deep cellules are seen. Just above the right ureteral meatus is a black small orifice, either of a diverticulum or deep cellule. Recto-urethral palpation shows no prostatic thickening, but a broad bar at the vesical neck over which the beak of the cystoscope can be distinctly felt to slip.

X-ray study. Cystogram and contrast cystograms showed medium sized diverticulum on the left side and a left hydroureter.

Operation, December 26. Extraperitoneal suprapubic excision of large diverticulum. Careful examination of the bladder revealed one large cellule above the right ureter. The vesical orifice was markedly contracted, but there was no prostatic enlargement. The neck was divided with the electric cautery, following which, upon attempt to dilate the vesical neck with the index finger, many prostatic stones were felt and were curetted out suprapubically. They lay, apparently, just below the prostatic commissure, and 84 seed calculi, ranging in size from a pinhead to that of a small pea with definite facets formed upon the majority, were removed.

Convalescence was complicated by a bronchial pneumonia from which he slowly recovered. The patient left the hospital January 15. Urination was normal with perfect control. The urine was still somewhat cloudy. No residual and patient feels perfectly well.

CASE 11. Male, age 74. P. C. No. 977. The patient has difficulty in urinating and retention, requiring periodic catheterization. He had a neisserian infection at 30. His past history is otherwise irrelevant.

About 13 months ago he had acute retention, necessitating catheterization by a physician and ever since this attack the patient has depended upon the catheter for relief three to four times each week, and during the last month he has had to catheterize himself two to three times daily. In the morning he is sometimes able to pass urine which he has noted comes as though a plug had been removed after great straining. No hæmaturia. He has not noted cloudiness of urine.

General examination is negative. Blood pressure 120–80. Wassermann, negative. The urine shows trace of albumin and occasional pus cells. Phthalein, intralumbar, 11–30: 10 minutes, 25

per cent, 20 per cent, 12/2; 10 minutes, 25 per cent, 25 per cent. Rectal examination: Prostate is slightly enlarged, soft and boggy to palpation, and shows marked adhesions on both sides to the rectal wall. Median furrow is shallow.

Cystoscopic examination. The patient has complete retention; capacity 300 cubic centimeters. Inspection of the vesical neck shows that it is œdematous with numerous bullæ, but there are no well marked notches, although shallow sulci are present in each lateral octant. There is a definite median bar formation posteriorly. The bladder wall, laterally and posteriorly, is quite markedly trabeculated with pronounced cellule formation throughout. In the mid-posterior portion, just above the trigone, there are a few small irregularly shaped pouches. The interureteral ridge is œdematous and markedly granular. Both ureteral orifices can be seen, and high on the lateral side above these are well marked black orifices, apparently of vesical diverticula. Recto-urethral palpation shows only slight thickening between the beak of the instrument and the finger, and this thickening is confined to the immediate region of the vesical neck.

X-ray study. Cystograms show medium sized diverticulum on the left side with a large cellule near the right ureter, well shown in the contrast cystogram.

Operation, December 3. Extraperitoneal suprapubic resection of the larger diverticulum. The bladder was markedly dilated and almost dumbell in shape. There were several small pouches posteriorly, and on the left, about 3 centimeters above the left ureter, was one into which the index finger could be inserted for 1 to 1.5 centimeters. On the right side in relatively the same position there is a considerably larger diverticulum which was resected. On palpation and inspection the vesical orifice was found to be small and markedly contracted, and there was no prostatic hypertrophy. The vesical contracture was widely divided with the electric cautery through the suprapubic incision.

Convalescence was uneventful, and by January 19, the patient was voiding freely and with perfect control. There was no residual urine. Bladder capacity, 130 cubic centimeters. Discharged January 4, cured.

CASE 12. Male, age 50. P. C. No. 696. Referred by Dr. F. W. Birtch. The patient complains of frequency of urination with burning and pyuria. His health has always been good. He has had 2 herniotomies, one 5 years ago, one 9 months ago.

Following the last herniotomy the patient first noticed a pulling sensation in the right side upon movement of the right leg, and this pain was so severe that he was unable to work on account of it. The pain radiated up to his shoulder and down to his right knee. He had noted that the pain was worse when his bladder became distended. There were no urinary symptoms before a cystoscopy a few weeks ago, following which time he has had pyuria, some hæmaturia and frequency. He came for examination because of the right-sided pain.

Fig. 19. Cystogram of Case 8. The smooth, even outline of the diverticulum and the ragged, uneven bladder border, due to trabeculation and cellule formation, are strikingly demonstrated.

General examination revealed no adhesions of the bladder to the old hernia scar, but the presence of an osteo-arthritis of the spine which might account for the right-sided pain. The patient was markedly psychoneurotic (postoperative). Blood pressure, 144–84; Wassermann, negative. The urine was negative before cystoscopy, following which, it contained many pus and red blood cells. Phthalein 10 minutes 60–10. Rectal examination: Prostate is not enlarged—gives no evidence of infection.

Cystoscopic examination. Bladder capacity 500 cubic centimeters; residual 40 cubic centimeters. There was slight trabeculation with small median bar at the neck. There was a large orifice of the diverticulum on the right side above the ureteral orifice as shown in cystogram. Patient not treated.

CASE 13. Male, age 45. P. C. No. 538. Referred by Dr. F. Gundrum. The patient has some difficulty and hesitancy, but no frequency, dribbling or pain. His chief complaint is impotency.

His health has been good. He gives a history of having had gonorrhœa twice with epididymitis and some small strictures at the meatus.

About 17 years ago he first began to have incomplete and partial erections and has had frequent

Fig. 20. Cystogram of Case 9. The contrast cystogram was unsatisfactory in this case and the irregular large shadow at the left was interpreted as an incompletely distended bladder. At operation it was found that there was a large diverticulum on the left side also (see Fig. 21).

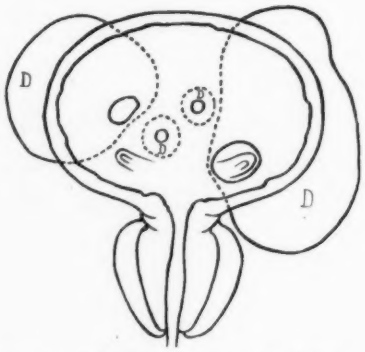

Fig. 21. Conditions in Case 9 as found at operation. The left ureter had to be transplanted. There were several deep cellules at the base, one of which was resected.

ejaculations without erections. He has never had nycturia and no burning or pain, but the force has for some time been definitely diminished. There is no cloudiness or blood. One week ago he consulted Dr. F. F. Gundrum who discovered a large residual, and referred the patient for a urologic study.

General examination is negative. Reflexes are active. Blood Wassermann 1+. The urine shows, microscopically, numerous pus cells, but no casts. Phthalein was not taken. Rectal examination: The prostate is not enlarged and negative to palpation; secretion shows 80 per cent pus, about 10 per cent lecithin and no spermatozoa.

Cystoscopic examination. The bladder capacity is 920 cubic centimeters; residual 620 cubic centimeters. Inspection of the neck shows no sulci, but a very definite median bar formation. The bladder is trabeculated posteriorly and above, and behind the right ureteral orifice is seen the mouth of a diverticulum, apparently of considerable size. The cystoscope can be inserted into the diverticulum, the walls of which are smooth and glistening and which contains no stone. Recto-urethral palpation shows no prostatic enlargement, but a very pronounced contracture at the neck.

Endoscopic examination. Shows that the vesical sphincter contracts tightly over the end of the instrument and shows no relaxation.

Impression. Diverticulum of the bladder, contracture of the vesical neck, chronic prostatitis. (NOTE.—Owing to the large residual in this case and the sexual debility, a question of spinal cord lues has to be considered, and the finding of a 1+ Wassermann is indication for antiluetic treatment).

CASE 14. Male, age 70. U. C. H. No. 280180. The patient has difficulty and frequency of urination; pyuria. He had neisserian infection at 21, 36 and 69; chancre at 21.

For many years the patient has had recurrent attacks of disability, accompanied with cloudy and frequent urination. He states that he knows when he is sick by watching his urine, feeling perfectly well when it is clear, and drowsy and indisposed when it becomes thick and cloudy. The stream has been of good size and there has been no hæmaturia or retention.

General examination is negative except for definite kyphosis. Wassermann is negative. The urine shows no sugar with a heavy trace of albumin and abundant pus; no casts. Phthalein 10 minutes, 25–20. Rectal examination: Prostate is slightly enlarged, and rounded with partial obliteration of median furrow and median notch.

Cystoscopic examination. The bladder capacity is 480 cubic centimeters, residual 80 cubic centimeters. Examination shows no sulci, but an apparent ring hypertrophy at the vesical orifice. The bladder wall is trabeculated and above the right ureter is seen the orifice of a large diverticulum. There is a small orifice on the opposite side above the left ureteral orifice. There are numerous shallow cellules. Plain and contrast cystograms are illustrated in Figures 23 and 24.

Recto-urethral examination shows uniform, but slight thickening between the examining finger and the shaft of the instrument.

Operation, October 1. Suprapubic extraperitoneal excision of the larger diverticulum. The smaller one on the left side not removed. A small collar fibrous hypertrophy was enucleated at the vesical orifice. Numerous seed calculi were removed. A small pouch near the left ureter admitted the tip of the finger for 2 to 3 centimeters and apparently has a very thin wall and an easily dilatable orifice.

Convalescence was uneventful. The suprapubic drainage closed quickly. The patient was discharged October 24, voiding normally with complete control. The urine still contains a small amount of pus.

CASE 15. Male, age 71. U. C. H. No. 21282. The patient complains of frequent urination with marked difficulty and hesitancy. He has had neisserian infection 12 times; the last time, 6 years ago. Chancre 30 years ago. He was operated upon for gall-stones 4 years ago. He had pneumonia 40 years ago.

About 20 years ago the patient had acute retention on account of two urethral strictures which were treated by dilatation, with relief for about 2 years, when he had a recurrence of retention necessitating redilatation. After this he had very little trouble for 3 or 4 years when, upon return of marked difficulty, he bought a sound which he has passed at intervals since. For several years he has had nycturia 5 to 6. About 4 months ago he was awakened with a severe chill followed by fever, which kept him in bed for 2 days. About a month ago he had a recurrence of chills and fever and retention of urine when he passed a sound, following which he had urethral bleeding and a very severe chill, on account of which he was sent to the County Hospital where he remained a week.

General examination was negative. Blood Wassermann, negative. The urine showed no albumin, sugar, or casts, but numerous pus and red blood cells. Phthalein 10 minutes, 15–35. Rectal examination: Prostate is slightly enlarged, uniformly indurated, median furrow is shallow; notch palpable. Urethral exploration revealed no strictures.

Cystoscopic examination. The bladder capacity is 325 cubic centimeters; residual urine 110. The vesical neck shows a small ring hypertrophy with no sulci laterally or anteriorly. The bladder is trabeculated with numerous cellules and above and inside of the left ureter is the orifice of a diverticulum.

Recto-urethral examination shows definite thickening between the finger and the shaft of the instrument.

Operation October 17, 1918. Suprapubic prostatectomy and extraperitoneal excision of diverticulum.

The patient's condition throughout convalescence was very satisfactory; temperature normal. But on October 21, 5 minutes after visit by interne to whom he stated that he was feeling unusually well, the patient suddenly jumped out of bed, cut his throat and wrists, and attempted to jump out of the window. He died 24 hours later of pneumonia and shock. Autopsy not obtained.

CASE 16. Male, age 55. U. C. H. No. 15038. The patient complains of marked frequency and burning on urination. He has occasional dribbling and hæmaturia.

His health has been excellent up to the present illness. He had neisserian infection at 25 and 32.

About 8 years ago for the first time he had dull pain in the lower lumbar region, and was treated by prostatic massage and bladder irrigations for several weeks when he had left-sided epididymitis, and ceased all treatment until 6 months ago, when

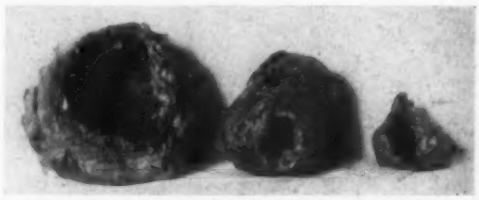

Fig. 22. Photograph of specimens removed in Case 9. (Considerable shrinkage after formalin fixation). (See Table II).

all his symptoms became worse. He was advised at this time to have his left testicle removed, and consulted another doctor two months ago, who gave bladder irrigations and also advised the removal of the left testicle. The irrigations gave no relief, and 2 or 3 weeks ago he began to pass considerable amounts of blood and he noted marked burning in the perineum. Frequency is every 30 minutes day and night, and there is occasional dribbling.

General examination is negative. Blood Wassermann is negative. Blood pressure, 120–62. Urine shows many pus and red blood cells, but no casts. Phthalein, May 20, 10 minutes 10–15; May 24, 10 minutes 15–15. Rectal examination: Prostate is hard and tender; but is not suspicious of cancer, median furrow obliterated; vesicles full and tense.

Cystoscopic study unsatisfactory on account of marked hæmorrhage. A large bladder tumor could be noted on the right posterior wall and there were shallow sulci, one anteriorly and one each in the posterior oblique octants. No diverticular orifices are seen. Cystogram shows one diverticulum on the right side. The patient had resection of the large bladder tumor, which showed, microscopically, malignant papilloma, and prostatectomy. The pouch on the right was about 3 to 4 centimeters in diameter and had thin walls and an easily dilatable orifice. Radium was used once subsequent to the operation, but the treatments were so painful that he has ceased to take them. Patient, although still alive, is losing weight and strength. He has taken up Christian Science and although all his urine drains suprapubically for which he changes towels every hour or so, he remains cheerful and deceives himself into believing that he is improving. He has been unable to work since leaving hospital.

CASE 17. Male, age 62. P. C. No. 937. The patient complains of frequency of urination with partial incontinence and marked general nervousness with pronounced asthenia. He denies venereal infection.

About one year ago he began to notice marked muscular weakness and nervousness, and about the same time urination became difficult and frequent. Nycturia 10 to 12. About six months ago he began to notice that he was losing control of urination, and nycturia persisted with the development of urgency so that he had almost a constant desire to

Fig. 23. Cystogram of Case 14 which fails to demonstrate a diverticulum. Compare with Fig. 24.

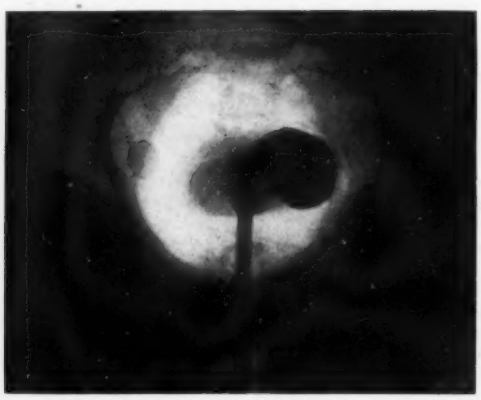

Fig. 24. Contrast cystogram of Case 14 which shows two small diverticula. The bladder is incompletely emptied of the thorium solution.

urinate. Amount voided each time was small. There has been a loss of 25 pounds in one year. Wassermann is negative. Blood pressure, November 23, 215–130. Urine, specific gravity, 1.008; albumin present; free pus cells and red blood cells. Phthalein, November 25 (intralumbar), 10 minutes, 40 per cent, 15 per cent. Rectal examination: Prostate is indurated, moderately enlarged. No suspicion of cancer. Median furrow is obliterated and notch shallow. Whole gland easily palpated. Vesical area is negative. December 10: Blood pressure, 185–120. December 8, phthalein (intralumbar), 10 minutes, 35 per cent, 20 per cent. December 3: Blood urea 26 milligrams. Non-protein nitrogen, 60 milligrams per 100 cubic centimeters. December 9: blood urea 23.8 milligrams. Non-protein nitrogen, 56 milligrams per 100 cubic centimeters.

Cystoscopic examination. The bladder capacity is 125 cubic centimeters; residual 100 cubic centimeters. Inspection of vesical orifice shows small bilateral and middle lobe hypertrophy. The bladder wall is a dull red color throughout, with marked granulation. Between and above the ureteral orifices there is marked trabeculation and above each is a black round orifice, apparently of well-marked diverticula. The one on the left is most distinct and shows star-like radiations. Urethrorectal palpation shows definite thickening between finger and cystoscope.

X-ray study. The cystogram shows a diverticulum on the left side.

Operation. Extraperitoneal suprapubic excision of diverticulum. Suprapubic prostatectomy. Diverticulum was about half the size of a walnut and exploration of the bladder shows a deep cellule above the right meatus and the bladder wall posteriorly markedly trabeculated and with numerous shallow cellules present. The prostate was largely of the ring type, quite fibrous and removed with some difficulty, the use of the curette being required.

Convalescence was uneventful until on the fourth day following operation, he developed definite signs of pneumonia. Leucocyte count, 22,000. Patient unable to combat complication and succumbed on December 19. Autopsy not obtained.

CASE 18. Male, age 68. U. C. H. No. 17210. The patient complains of frequency of urination with urgency; no marked difficulty; pyuria. His health has been excellent. He has had no infectious diseases and denies venereal infection.

About 5 years ago he began to have frequency and very soon afterward noted small amounts of blood in the urine. After a few months blood disappeared and has never recurred. About a year ago the patient noted a small lump above and to the right of the symphysis which disappeared after urination and then slowly made its reappearance until the next urination. He has much pain in this region. He had no difficulty, burning, or pain on urination, except that occasionally he had severe pain at the neck of the bladder.

General examination is negative except for the mass above noted, which is somewhat tender and soft and reaches sometimes the size of about 5 centimeters in diameter. The Wassermann is negative. Blood pressure, 140–78. The urine shows numerous pus cells and many bacteria. Phthalein, 10 minutes, 10–10. Rectal examination shows a slightly enlarged prostate with a shallow median furrow and definite sulci laterally.

Cystoscopic examination. There are deep sulci anteriorly and in the left lateral and right posterior oblique octants, indicative of a bilateral and middle lobe hypertrophy. Three stones are seen to lie in the base behind this hypertrophy. The bladder wall is trabeculated and four separate black orifices,

Fig. 25. Cystogram of Case 12 . A definite diagnosis of diverticulum could not be made from this picture alone.

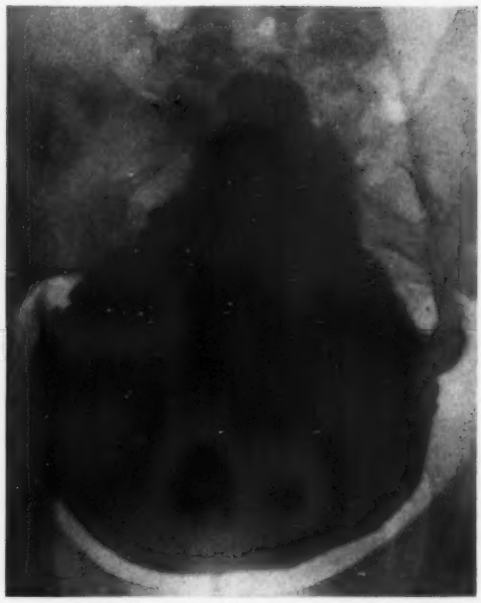

Fig. 26. Cystogram of a case in a man aged 64, with a marked contracture of the vesical neck who was operated upon suprapubically. Cystoscopically no diverticulum could be found and careful exploration of the bladder at the time of operation revealed none. The man had an uneventful recovery and is well. The cystogram is shown in order to illustrate the value of contrast pictures and also the tremendous effect on the ureters and bladder of back pressure from simple contracture of the vesical neck.

apparently of diverticula, can be seen. Two of these are near the regions of the right and left ureters, respectively. One is 3 or 4 centimeters above the right ureter and is best seen in the right lateral far position of the cystoscope. The fourth is a narrow, rather oblong-shaped orifice on the right side, toward the middle of the posterior wall. Recto-urethral examination shows definite thickening between the finger and the shaft of the instrument, the beak of which cannot be definitely felt.

Plain X-ray pictures show stone shadows in the bladder. Pain and frequency of urination, following cystoscopy, were quite marked and on April 25, under local anæsthesia, a suprapubic cystotomy was performed and three stones were removed. The patient gradually improved under suprapubic drainage and on May 21, suprapubic prostatectomy was performed. At the time of the operation the diverticula were located with the examining finger and the two in the region of the ureters were found to be quite deep, the one of the left side being the largest and was seen to extend well down between the rectum and the prostate. The two pouches on the right side were not far distant from the ureteral orifice and were apparently small and with very thin walls. Owing to the patient's generally poor condition, the diverticula were not resected; this being left for a future operation if found necessary. A bilateral and middle lobe were removed in one piece, each of the same size, approximately 2 by 3 centimeters.

Convalescence was uneventful. The suprapubic fistula quickly closed. The patient voided normally through the urethra, although the urine still remained purulent. He was discharged, June 22, to return for observation. The patient has not been seen since leaving the hospital.

Case 19. Male, age 69. U. C. H. No. 22683. The patient complains of frequent painful urination and continuous dull backache. He had a neisserian infection at 41. The patient's history is otherwise irrelevant.

For more than 15 years the patient has been troubled with painful and frequent urination which has been more or less intermittent. The pain is referred to the neck of the bladder and is most marked at the beginning and end of urination. He has thought he had milky urine at certain times. He has also noted that the stream will sometimes stop almost completely and will start again in a few moments. Recently there has been difficulty in starting and the force is diminished. There has been

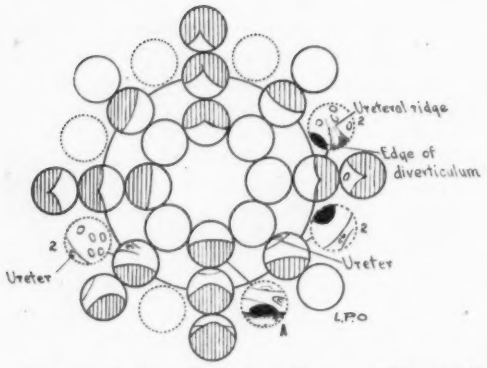

Fig. 27. Cystoscopic chart of Case 19 which records the relation of the orifice of the diverticulum to the left ureteral meatus and ridge and a small bilateral and median lobe prostatic hypertrophy. (Drawing in dotted Circle A is neither a cellule nor the orifice of a diverticulum, but a deep pouch below the interureteral ridge). The diverticular orifice is best seen with the cystoscope in the horizontal position rotated toward the left posterior oblique octant (*L. P. O.*) (or the left lateral) and pushed in beyond the vesical margin to bring the field above the interureteral ridge into view (shown in the dotted circles of the chart, numbered 2, to indicate the mid-zone of the bladder).

periodic hæmaturia in the last 15 years, and during this time periodic attacks of dull pain in right and left lumbar region. Symptoms have been markedly aggravated during the last two weeks and he has lost weight and appetite. He has never used a catheter.

General physical examination is negative. Blood pressure, 100–70. Urine shows trace of albumin. Specific gravity, 1.021. Many pus cells present. Phthalein (intralumbar) February 23, 10 minutes, 45 per cent, 30 per cent. Rectal examination: Prostate is markedly enlarged, rounded, with deep lateral sulci. Furrow and notch are obliterated, upper limits barely reached with the examining finger.

Cystoscopic examination. February 25, shows a large bilateral intravesical hypertrophy. The bladder wall is markedly trabeculated posteriorly, and there is one large opening apparently of a diverticulum, on the left side in the posterior oblique position of the cystoscope. There are numerous cellules posteriorly on the right side. The shaft and beak of the cystoscope can not be palpated by the finger in the rectum showing considerable recto-urethral thickening. (See cystoscopic chart, Fig. 25.) Cystogram shows medium sized diverticulum on the left side.

Operation, March 4. Suprapubic prostatectomy. Exploration of the bladder at the time showed a deep pouch with its orifice about 1 centimeter above the left ureteral orifice which will admit the tip of the index finger for 2 centimeters and with an easily dilatable orifice. There is a similar small pouch in a corresponding position above the right ureteral orifice, and just inside this is a third orifice into a somewhat smaller cellule. The bladder wall is markedly trabeculated with shallow cellules posteriorly. The diverticulum was not treated surgically.

Convalescence was uneventful. The patient has not been heard from since discharge.

CASE 20. Female, age 40. Referred by Dr. Max Rothschild. The patient has suffered poor health for 30 years. She has been married for 24 years. More than 20 years ago she had an apparent severe attack of cystitis of the bladder and since this time she has never been completely free of bladder symptoms, although there have been periods of relative improvement. At the worst she has frequency as often as 52 times in 12 hours. There is an almost continuous desire to void, and during the last few years there has been infrequent dribbling, particularly during attacks of coughing. During all this time the urine has usually remained clear. For several years she has been known to have pulmonary tuberculosis and has been under treatment for this at the California Sanitorium for the last 2 years and has shown remarkable improvement. During these 2 years repeated search of the urine for tubercle bacilli has been made with negative results and guinea-pigs have been inoculated with urinary sediment on 4 separate occasions with negative findings.

General examination is negative except for the lung findings. The uterus is somewhat retroflexed but freely movable, and there is no evidence of a cystocele; no urethral caruncles and careful examination of the urethra reveals no polyps or other abnormalities. Proctoscopic examination was negative. Urine shows only an occasional pus cell; no albumin; no sugar; no red blood cells and repeated examinations, as mentioned, have all been negative for tubercle bacilli. Phthalein, 10 minutes, 40–15.

Cystoscopic examination. The bladder capacity is 240 cubic centimeters; residual 10 cubic centimeters. Vesical neck is negative; bladder wall is slightly trabeculated, but very careful search on 3 different occasions has failed to reveal any evidence of ulcer. No stone or tumor present. Above and to the inner side of the left ureteral orifice is the round mouth of a diverticulum. Ureters were both catheterized. Double pyelograms were made with perfectly normal findings. Guinea-pigs were inoculated from separate kidney specimens and were found negative. Cystogram shows a medium sized diverticulum on the left posterior side of the bladder. The patient is to have the diverticulum resected so soon as her pulmonary condition will warrant.

CASE 21. Female, age 56. P. C. No. 916. Seen in consultation with Dr. J. W. Ward. The patient has had urinary symptoms for 15 or 20 years and has had repeated treatments for cystitis. For some months there has been dribbling and partial incontinence and the urine has been markedly purulent. She has had infrequent attacks of chills and fever and considerable bladder pain, and for

several months has been confined to her bed almost continuously.

General examination is negative. The uterus is in good position and there is no cystocele; no caruncle, polyps of the urethra, or other abnormalities. The urine is very foul and purulent and contains an occasional cast. Phthalein, first hour, 10 per cent; second hour 15 per cent.

Cystoscopic examination shows a markedly trabeculated bladder simulating in every way the bladder seen in men, with contracture at the neck or prostatic hypertrophy. The bladder capacity is about 620 cubic centimeters; residual 310 cubic centimeters. Numerous deep cellules are located about the orifices of both ureters and on each side the black mouths of deep diverticula are seen. Cystoscopic study indicated that there were four definite diverticula. Unfortunately a cystogram was not made. The patient has moved to Los Angeles so that further study has not been possible.

SUMMARY OF ANALYSIS OF 21 CASES

A vesical diverticulum is not a rare finding in urologic practice. It occurs most frequently in men over 50 years, the average age being 56; youngest, 37; oldest 77. It is very exceptional in women (2 cases, ages 40 and 56), and in this series no instance has been seen in children.

The diagnosis is made definitely by careful cystoscopic and cystographic study. Cystography is more accurate when both plain and contrast pictures are taken. The cystoscope is unreliable for accurate determination of the size and position, and the simple cystogram may fail to show even a large diverticulum. Properly used in conjuction the three methods give reliable information.

In 17 operations in which the number and relative position of the diverticula were determined by direct examination, a single large diverticulum was present in 11 cases, two large diverticula in 4 cases, and three and four large diverticula each in 1 case. In every case of single sacculation the orifice was located in the neighborhood of an ureteral orifice. In the cases with two diverticula there was usually one each near the respective ureteral meatus. The base showed a diverticulum only when the neighborhood of the ureteral orifices had diverticula, and in these instances the diverticulum at the base was always the smallest. In not one case of the 17 operations was the region of one or the other ureteral orifice uninvolved.

The base and posterior walls of the bladder were markedly trabeculated in every case. Large cellules easily admitting the tip of the gloved index finger were located in the neighborhood of the opposite ureter in 9 of the 11 cases of single diverticulum, and in the base of the bladder in 3 of 5 instances of multiple diverticula. In no instance was the mouth of the diverticulum or the cellule found on the high lateral or anterior walls of the bladder. The ureter was shown by the cystogram to be markedly dilated on the right in three cases, and on the left in two; both ureters were dilated in one case.

The walls of the 22 diverticula removed at operation vary in thickness from ¼ millimeter to ½ centimeter, and this variation in thickness exists for different portions of the wall of the same diverticulum, even the thickest having some extremely thin and transparent areas. There is a remarkable absence of epithelial lining to the diverticula which may be the result of surgical trauma. In the one case which showed a lining it was a thin pavement epithelium unlike bladder mucosa. The inner surface of all sacs showed a chronic inflammatory reaction.

The muscle of the walls showed no definite arrangement into layers in any way analogous to the vesical muscularis, but invariably occurred in sparse or heavy bands scattered in more or less dense connective tissue. In some of the walls these bands, by their transverse or longitudinal course, indicated an imperfect circular or longitudinal layer.

A contracture of the vesical neck was found in association in 13 cases and received surgical treatment in 8. A small fibrous or ring prostatic hypertrophy was removed suprapubically in three cases and perineally once. A large glandular prostatic hypertrophy complicated two cases. The diverticula in all of these six cases associated with prostatic enlargement were relatively small and were untreated surgically in three cases, in the two large glandular and in one fibrous hypertrophy. In the two cases in women, which have not come to operation, no definite obstruction to urination other than that attributable to the diverticula was found.

An analysis of symptoms disqualifies vesical

diverticulum as a distinct clinical entity. The onset, course, and termination duplicate the clinical picture of prostatism. With respect to urination the onset symptom was: difficulty in 14 (with frequency in 7, with urgency in 4, with hesitancy once and simple difficult urination twice), complete retention occurred at the onset in 3 cases, two of which had contractures of the neck, and the other a small fibrous hypertrophy. Diminution in the urinary force, pyuria, pain in the lumbar region and pain in the right side were the respective initial symptoms in four cases. Cloudy urine was first noticed on an average of 6 years, and was absent altogether in 5 cases, whereas the average duration of symptoms since onset is 16 years. Vesical calculus complicated the anomaly only once.

PREGNANCY AND LABOR FOLLOWING AMPUTATION OF CERVIX UTERI[1]

By O. S. PAVLIK, M.D., Chicago
Attending Gynecologist, Wesley Memorial Hospital

COMPLETE amputation of the cervix uteri by the Schroeder method has been performed with great frequency since 1878, but the effect of the operation upon subsequent gestation and labor has produced hitherto only an unimportant literature. Leonard alone has given the subject the dignity and importance it seems to deserve.

Whether this dearth is due to inattention or to oversight, it is difficult to say. It can hardly be owing to a lack of complications in these cases. What literature we have, abundantly indicates the gravity of the association.

To be sure La Tarre believes that pregnancy and labor is undisturbed and Marisani thinks it would be undisturbed if the operation was well done, and if there was no subsequent suppuration, but the question has never been authoritatively decided.

Authors are to be found in the literature, however, in sufficient numbers, who were not so favorably impressed with the operation as to let the question go undiscussed. Thus Cuzzi and Resinelli report four cases of which only two went to term and Gottschalk observed frequent instances of abortion and premature labor. Audibut reports sixteen cases of which only five went to term and the various interruptions were characterized by much hæmorrhage and more than the usual proportion of abnormalities. In his collection he found ten vertex, two breech and three shoulder presentations, which required four artificial extractions, and the series resulted in a total fœtal mortality of 20 per cent.

It is only fair to state, however, that these consequences in the opinion of Pozzi, La Tarre, Marisani and others are regarded as evidences of bad technique.

Modern gynecologists are also seriously divided on the question which nevertheless has received relatively little attention. Lynch is inclined to be optimistic and Goldstine informs us that in his one case the labor was almost precipitate and for this reason he thinks the unfavorable attitude is hardly warranted.

For the most part, however, the current of authoritative opinion runs rather contrary to the operation in child-bearing women.

Thus, Peterson, of Ann Arbor, reports a case in which the amputation was followed by a prolapse, and pregnancy and labor supervened. After eighteen hours of relatively hard pains, a vaginal cæsarean section was done, followed by version and extraction.

Edgar, in a personal communication, says that he always dreads such labors, for tears into the broad ligament are imminent. He believes that the operation should not be done where subsequent pregnancy is probable, but given such a case he advocates the cæsarean operation.

J. Whitridge Williams regards the operation as the most frequent cause of premature labor with which he is acquainted, even

[1] Read before the Chicago Gynecological Society, April 18, 1919. (For discussion see p. 205.)

detention in bed being insufficient to prevent the disaster. In other cases, he states that the scar is productive of prolonged and difficult dilatation, which frequently necessitates artificial assistance and results in severe labors in women who have had easy labors previously.

In other cases Williams found such complete cervical atresia that while the entrance of spermatozoa had been possible, no trace of a cervix could be found at term and cæsarean section was imperative.

E. P. Davis mentions one case in which premature labor developed and artificial dilatation was necessary. In another case, after long delay in the first stage, the labor was terminated by manual dilatation and forceps. In two other cases cæsarean section was the only means of evading the difficulties presented by the mass of cicatricial tissue. He is of the opinion that the *complete* amputation of the cervix is an undesirable operation during the child-bearing period, as a normal labor subsequently is quite exceptional.

Newell, of Boston, feels that while the scar tissue may soften up and delivery occur, yet in many instances the cicatricial ring is an insuperable obstacle to delivery. He also suggests that these cases should be sterilized if the complete amputation is done and if the woman should go to term the cæsarean operation is advisable.

With these quotations which freely illustrate the seriousness in which the operation is held and the variety of complications which it may furnish during pregnancy and labor, we take the opportunity of reporting a case which came into the service of Reed at Wesley Memorial Hospital.

Patient III-para, age 35. Pelvic measurements were: Sp. 21; Cr. 26; Ext. C. 16 plus.

First pregnancy miscarried at three months; second went six weeks over the calculated time and after three days of labor, pubiotomy was done and a 12 pound child extracted that lived 24 hours. The patient had a complete tear of the perineum. Six months later the Schroeder operation was done on the much mutilated cervix.

The patient came into Dr. Reed's service in the fourth month of her third pregnancy. The cervical scar was a hard inelastic ring which at no time softened. Fearing the patient might go into labor with disastrous consequences a cæsarean section was performed about two weeks before the calculated maturity of the child and on January 23, 1918, a six and one-half pound male babe was delivered. The classical operation was done and the patient was sterilized by resection of the tubes before the abdomen was closed. Both mother and child made uneventful recoveries.

My own case which aborted had the following history:

Mrs. S., age 25, married 6 years, had a difficult forceps delivery 18 months after marriage. She had a miscarriage a year later at three months. Shortly afterward an amputation of a badly lacerated cervix was done. Since the operation she has had three miscarriages at six and one-half, four and three months respectively.

I saw her in the third month of her sixth pregnancy. She complained of pain and bleeding. Two days later she miscarried. At present she is again about two months pregnant. She refuses to be sterilized.

The gynecological aspect of the question has been well covered by Leonard in his excellent report of the Johns Hopkins' cases, published in 1913, in which he includes the statistics after operations. In all, one hundred and twenty-eight cases are analyzed. We have carefully revised his bibliography and can find no valid reason for going back of his paper again; it is complete to the date.

In women who are approaching the climacteric, there can be no question as to the value of this procedure; but should the operation be done on patients who are liable to conception? This is the question which seems to need further discussion.

Happily sterility is not uncommon after the cervical amputation, for, according to Leonard, less than 20 per cent are found to conceive. This is owing to cicatricial contraction, stenosis of the os, and possible other changes.

Leonard goes on to show how, by Kelly's technique, these conditions may be avoided, but it seems to the writer that whenever the operation is done, sterility should be definitely assured by an intentional technique. This opinion is based first on the frequency of abortion, which is admittedly about 50 per cent (Leonard), and more particularly on the dystocia in which the case will probably terminate.

In this connection the cases reported in the

early years of the operation cannot be considered, for the stump was allowed to heal by granulation and the results were not ideal, but since then, the repair work has been carried out more carefully, with aseptic precautions and good technique, but the operation still shows so large a proportion of hazardous labors as to make one hesitate to employ it during the child-bearing period.

The scar tissue must produce physiologically a certain amount of contraction under the most favorable circumstances and the ring of the new cervix is necessarily less elastic and more liable to laceration when the child passes. Such laceration is in no way under control and may easily extend into the broad ligament.

Pinard, Guibont, Martin, Pescher, Tarnier, and many others, concur as to seriousness of the obstetrical mishaps which may attend such a delivery and indicate the frequent necessity for cæsarean section.

In Leonard's own series of fourteen cases, 11 or 64 per cent had serious dystocia while only four had easy labors.

The whole question turns, more or less, on the functional importance of the cervix. The value of the cervix to a pregnant or laboring woman seems to have found few investigators in literature in spite of the vast mass of discussion which developed regarding Bandl's ring and the lower uterine segment.

Whether or not the cervix becomes a part of the lower uterine segment is not the province of this paper to set forth. Abler men have spent an enormous industry thereon. But one point at all events seems clear: The cervix acts as does a puckering string to a bag, or as a stopper to a bottle, so far as it relates to the gestating uterus, and its removal subjects the patient to the theoretical and, as the cases seem to show, to an actual danger of uterine evacuation at all stages of pregnancy. The danger of premature delivery which affects at least 50 per cent of the cases as statistics show and as authorities agree, is seriously added to by those tissue changes which inevitably take place in the amputation stump.

Studdiford, having in mind the complications to labor which we have cited, recommends as a routine that amputation should never extend higher than one-half inch below the internal os in order to anticipate the alterations, such as marked shrinkage of the entire uterus which interferes with the power of the organ to complete its functional cycle. It therefore excludes the true Shroeder technique.

But even with this modification, it seems to the writer that Leonard's conclusion must be fully endorsed; namely, that serious dystocia will commonly arise from the cicatricial rigidity that follows the operation, and that the operation should not be performed on women during the child-bearing period unless more conservative measures have failed, and further if the operation should be done during the child-bearing period, the patient should at the same time be sterilized.

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OCCURRENCE OF NEW-GROWTHS IN THE ABDOMINAL WALL AFTER LAPAROTOMY[1]

By W. C. DANFORTH, B.S., M.D., F.A.C.S., Evanston, Illinois

In 1916 Balfour reported seven cases of desmoid tumors which had occurred in the Mayo Clinic. Of these, two had occurred in laparotomy scars and after a careful review of the literature he was not able to find any other cases which had followed operation. A review of the literature to date has brought to light no reports of similar cases in American literature and none in such European reports as are available unless two very inadequately reported cases, one in the French and one in the German, should belong to this class of growths. In the past year two new-growths in laparotomy scars have occurred in my own experience, one being a true desmoid and the other a fibrosarcoma. One of these was a private patient and the other occurred in my hospital service. The cases are as follows:

Case 1. Widow, age 40, had undergone appendectomy in 1911 and abdominal hysterectomy in 1915, by a surgeon in the South. Several months before entering the hospital here, she had noticed a swelling at the right side of the lower end of the median abdominal scar. This had been slowly growing, moderately tender to pressure but not painful. Upon examination the mass was firm, only slightly movable, not adherent to the skin and gave no impulse upon coughing. Upon operation a mass 5 by 4 by 3 centimeters, irregular in shape, apparently arising from the fascia of the abdominal wall was excised. The underlying portion of the fascia was also removed. The peritoneum was opened and the abdomen found to be completely negative. The pelvis was in excellent condition, free from any adhesions; gall-bladder negative. Upon microscopic section this mass showed distinct evidences of fibrosarcoma, being composed almost conclusively of spindle-shaped cells with very distinct nuclei closely associated with polarity but little disturbed. She was then given intensive X-ray treatment during her stay in the hospital. A few months later she informed me by letter that a growth was reappearing and that she was undergoing X-ray treatments in the medical department of a Western University. She subsequently returned to me at which time a mass 15 centimeters in diameter, hemispherical, red and fluctuating on the top, was found in the lower half of the abdominal wound and she shortly after entered the Cook County Hospital where she came under the care of John A. Wolfer, to whose courtesy I owe the report of the operative findings at that time. He found a tumor, soft, broken down in the middle, densely adherent to the abdominal wall, requiring resection of the fascia and a portion of the fundus of the bladder. The pathologist at that institution however, pronounced it to be non-malignant.

Case 2. The patient, age 24, single, had had six years previously a median laparotomy at which time the appendix only had been removed. The pelvis at that time was said to be normal. This patient presented a mass in the lower third of the scar, easily felt under the skin, hard, tender, only slightly movable. Incision was made through the old scar and an irregular, spherical, hard mass about 2 centimeters in diameter was excised with its fascial attachment. The abdominal wound was opened. No adhesions to the side of the old wound were present. The uterus was normal in size and position but a right ovarian cyst, about 10 centimeters in diameter, was found and excised. The abdominal mass on microscopic examination was found to consist of hard, fibrous tissue, arranged in bundles, the fibers in many areas giving a wavy effect, the typical microscopic picture of desmoid. The ovarian cyst contained a non-malignant papilloma.

Of the seven cases which Balfour reported, two, only, had occurred in laparotomy wounds. The second of the two cases noted above being a true desmoid tumor should, I think, be added to the two contained in Balfour's report. Tavernier and Chalier give a brief report of a growth in the scar of an old gastro-enterostomy wound, the mass being hard, white, and apparently cartilaginous in character. No histological findings are given in this report.

Pollosson reported a case of a growth which had occurred in a woman, aged 59, upon whom a difficult hysterectomy had been carried out, there being a neoplasm of the uterine body. The character of the neoplasm was not definitely stated. Four years after operation a large abdominal tumor had appeared extending below as far as the pubes over which it had pushed slightly and extended laterally for about 3 centimeters on each side. It was 5 to 6 centimeters in depth and had lost all

[1] Read before the Chicago Gynecological Society, April 18, 1919. (For discussion see p. 205.)

lateral mobility. The skin was reddened at one area and the tumor was apparently softened at that point. Extirpation was done. The bladder wall was injured but the patient made a good recovery.

The author gives no details as to its histological character and one can therefore not say whether this belongs to the relatively benign class of desmoids or whether it was a tumor of malignant character.

Fibrous tumors of the abdominal wall are not at all uncommon, as a report appeared in 1904 by Pfeiffer showing a collection of more than 400. Their etiology like that of other tumors, is not altogether clear. Pregnancy, however, seems to be a definite predisposing factor, inasmuch as in the majority of individuals in whom they are found, pregnancy has occurred.

As to sex, as Balfour points out, they occur in women in the ratio of 7 to 1. It is possible that the stretching of the abdominal wall incident to pregnancy, together with the possible tearing or rupture of some fibers in the aponeurosis of the rectus and oblique muscles may furnish the trauma necessary to the starting of a new-growth.

The difference of the susceptibility of the peritoneum in different individuals and its influence upon the subsequent production of adhesions has long been noted. It is possible that there may be similar variations in the susceptibility of aponeurotic tissues in different individuals.

Saxon and Corwin-White, in a study of tumor formation in both plant and animal life, call attention to the condition experimentally produced by L. Loeb in guinea-pigs. He found that if an incision were made into the uterus of a guinea-pig in certain early stages of pregnancy, there would be formed nodules having the structure of decidua. He made transverse and longitudinal cuts in the uteri of anæsthetized animals. The nodules were due to a proliferation of interglandular connective tissue of the mucosa. The tumors grew rapidly until about the thirteenth day and then quickly disappeared. While these growths were produced only in pregnancy and were evidently due largely to its presence, still, as they were composed of connective tissue and appeared after a wound of the uterine wall, it would seem that a moderate trauma bore a definite relationship to their appearance. The pregnancy itself, however, is not supposed to have any relation to the appearance of desmoids except as the source of a possible trauma provoking possible slight injuries of the aponeurotic structures.

The diagnosis of these tumors is as a rule not difficult. The most careful discussion of diagnosis is given by Pagenstecher. They occur most frequently in the sheath of the rectus and upon the aponeurosis of the oblique muscles. They are usually irregularly round with rather sharply defined borders and when being grasped are not movable upon the underlying tissue. Upon being forcibly moved the underlying abdominal wall moves with them. The most characteristic point is that when the abdominal wall is under tension they disappear, while when it is relaxed they become easily noticeable. They are ordinarily small but have been noted as large as the size of the fœtal head.

They must be distinguished from sarcoma, hernias of the muscle, lipomata, and from inflammatory growths in scars following laparotomies. The differentiation from all of these should, however, as a rule not be difficult. Pagenstecher includes what he calls Schloffer's tumor among the growths which should be differentiated from desmoid growths. This is a chronic inflammatory process described in 1908 and was found to follow hernia operations. Schloffer reported four cases of this type all after herniotomies.

The time between the operation and the appearance of the tumors had varied from some months to five and one half years. The growth of this lesion is always slow and usually not accompanied by any functional sign. These tumors are usually globular or ovoid, with a smooth, irregular surface. They are subcutaneous and the skin over them shows no signs of œdema. Upon incision one finds in the center of the growth, a small abscess in which a piece of silk suture is embedded. After the removal of this, the growth disappears spontaneously. As silk sutures in laparotomies and herniotomies are in this

country practically never used, this growth is undoubtedly one which would not be seen here, hence would scarcely enter into our differentiation.

Upon diagnosis treatment is quite clear. The mass should be excised immediately. The excision should include the removal of that portion of the aponeurosis which forms the base of the tumor. This occasionally means that a considerable area of the underlying aponeurosis must be sacrificed. In case so much is removed that closure is rendered difficult, closure with transplantation of fascia ordinarily taken from the fascia lata must be considered. Excision of this growth should be followed by careful microscopic investigation in order that the occasional occurrence of malignant growths such as the one contained in this report may not be overlooked.

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THREE NEW AMPUTATIONS OF THE FOOT DESIGNED TO RETAIN THE CALCANEAL TREAD

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TIBIOTARSAL and transtarsal amputations have always provided material for thought and discussion among surgeons. But it appears to be agreed that if they are to be done at all, it is very important that the stumps of such amputations should always be provided with good weight-bearing ends.

In October, 1914, I had to deal with a hopelessly crushed foot, when it occurred to me to shear away part of the under surface of the talus and the upper part of the calcaneus and to fit then the two plane surfaces in apposition after removing the projecting greater process of the calcaneus. The result was in every way excellent, and it remains so to this day. Shortly afterward I had a similar problem to solve after a traumatic gangrene of the anterior part of the foot. I performed a very similar operation, with an equally satisfactory result. Space forbids here a detailed account of these two cases, but I hope to be able to describe them at length in another paper which will probably appear in *The Medical Journal of Australia*.

Stimulated by the success of these two endeavors, I then undertook a very long series of experiments on the cadaver in order to study possibilities, to discover defects or improvements, and to elaborate a technique which might provide the easiest, safest, and most promising mode of arriving at a good result. The study has not only been extremely interesting, but it has ended in the development of two further operations which seem to promise exceedingly well in suitable cases. I propose to present at once a fully detailed description of the operative technique, and then to a discussion of the points that seem to recommend the operation, or rather, the three several operations, which I have distinguished for convenience as No. 1, No. 2, and No. 3.

But before beginning, I want to say that I think I have good reason for strongly advising prospective operators to follow so closely as possible the detailed technique that will be described. No doubt the actual necessities of an individual case may compel some modifications adapted to the situation, but the

rule should be to practice all variations first on the cadaver. I may say that I have tried a very large number of imaginable variations in the endeavor to find improvements or to eliminate difficulties. In my own work, each specimen of every series has been radiographed in two positions, and the specimen has afterward been boiled down for examination as a dry bone-preparation. My experience has several times proved that a modification seemingly attractive at its first conception may show up unexpected defects when tested in practice, and such experiments should not be made arbitrarily, at the possible cost of the living. At all events, if the technique that I have gradually developed be followed carefully, and with all its steps strictly according to the sequence laid down, a satisfactory result may be confidently expected, and it will be attained with comparative ease.

INSTRUMENTS

The special instruments that will be required in addition to the stock instruments needed at every operation, are as follows: A sharp osteotome, mallet, gouge forceps, bone shears, sequestrum forceps, lion forceps, rugine, a simple drill of awl type, wire guides, silver or bronze wire of thick gauge, so as to have some stiffness. For work on the cadaver I used copper wire of a minimum diameter of 1 millimeter and a maximum of 2 millimeters.

STEPS OF OPERATION NO. 1

1. *Flaps.* Preserve all viable material, or at least an ample surplus, and trim down later. In a formal operation on the cadaver one may cut flaps like those for a Chopart. The upper flap is cut by an incision starting at a point midway between the tip of the lateral malleolus and the tuberosity of the fifth metatarsal bone and coming across the dorsum of the foot to a point a little behind the prominence of the navicular bone on the medial side of the foot. As the cut crosses the dorsum of the foot it curves forward somewhat, crossing the bases of the metatarsal bones. The plantar flap extends a little farther forward on the sole than the upper flap does on the dorsum. But it is better to have some surplus to cut down than too little to work with.

2. Disarticulate at the mediotarsal joint, as in Chopart's operation. The head of the talus and the greater process of the calcaneus are now exposed to view. The talus projects about 5 millimeters further forward than the calcaneus. Clear them somewhat, so as to get a better exposure of the head of the talus.

3. With the osteotome cut a horizontal sulcus round the head of the talus, at a level about the junction of the upper two-thirds with the lower third of the presenting convex articular surface. The sulcus is deep enough to penetrate the hard crust of the bone as far round as possible. Then deepen the sulcus until the lower third of the head of the talus has been removed. Shave the plane surface underneath the remainder, so as to give the plane a certain amount of slant upward as the cut runs backward. The interosseus ligament is now exposed to view.

4. With the osteotome cut through the base of the sustentaculum tali flush with the side of the calcaneus, sever its ligamentous attachments and remove it.

5. The next step makes for ease in subsequent work. With the osteotome cut a horizontal sulcus across the facet on the front of the greater process of the calcaneus which formerly articulated with the cuboid. The sulcus is placed at about a level which marks off the upper third of this surface from the lower two-thirds. Having made the sulcus, cut backward and upward from this mark with the osteotome toward the groove just in front of the convex articular facet on the upper aspect of the calcaneus. This is the groove which contains the calcaneal attachment of the interosseus ligament. The cut removes the sharp, upward-curving projection at the anterior extremity of the calcaneus. If left alone, it would be found to hamper freedom of access to deeper portions of the field of operation (Fig. 2).

6. Cut away the interosseous ligament cleanly from its proximal and distal attachments. Let the assistant grasp the prominent part of the calcaneus with lion forceps and draw it down, away from the talus. Cut the lateral, medial, and posterior talocalcaneal

ligaments, and separate the soft tissues from the upper surface of the calcaneus with a rugine. Then separate the soft parts from the sides of the calcaneus with a rugine, aided, when required, by the knife, and take care also to sever the attachment of the calcaneofibular band of the lateral ligament of the ankle to the tubercle on the lateral side of the calcaneus. Never forget to keep all cutting edges directed toward the bone and away from the surrounding soft tissues. Cut short the long flexor tendons of the toes, and that of the hallux, as far back as convenient.

7. Now turn to the talus again. The plane of section already begun through the head and interrupted by the attachment of the interosseous ligament is now carried backward and a little upward, until the whole under aspect of the bone presents a flat cut surface, with a slant upward, so as to shave off the whole of the articular surface. In beginning the cut, make a sulcus as far as possible right round the downward-projecting process that is immediately encountered, and then gradually deepen the cut until the process is severed. This is done to avoid fracture, and to ensure cutting in the right plane. A plane sloping too much upward will remove too much of the posterior part of the talus. A careless or clumsy operator might cut up into and injure the posterior tibiotarsal ligament, or he might even enter the ankle-joint. Yet if there is not enough slant, the articular surface will not be completely shaved off posteriorly. It is quite easy to shave off thin parings of bone to produce any slope required, so there is no need to run any risk whatever by massive cuts. Indeed, experience teaches that throughout the whole operation progress attained by small cuts and thin shavings is always the best.

8. We are now ready to return once more to the calcaneus. The removal of the promontory of bone from the greater process has so beveled it down that, with the removal of the interosseous ligament, it has become possible to apply the osteotome at a slant, so as to shave off successive layers of the convex articular prominence of the calcaneus. Shave away this and the bone immediately beyond until a large plane surface has been produced with a moderate slant up from before backward. It is here very important to shave, and not to make any attempt to cut massively, a point I have had repeatedly brought home to me in experimental work. If any rash person neglects this advice, he will find that ease of fitting will be replaced by difficulty. The plane of section cuts the bone so that the posterior margin of the section reaches a point on the saddle-shaped superior surface behind the posterior limit on the convex articular facet (Fig. 2). If the plane of section is too horizontal, and the cut surface passes right back on to the smooth area on the posterior surface facing the Achilles tendon, then close approximation of the bones at this situation is less easy to obtain, and there is, moreover, a greater tendency for the soft tissues to crowd in between the opposing cut surfaces. There is also a much greater tendency to splintering of the bone further back, and the increased hardness of the cortical layer tempts to too great violence with the osteotome. But, on the other hand, if the slope of the section is too steep, and if it does not extend far enough back, it offers an impediment to the intended advancement of the calcaneus, and to the fitting of it in the new position. However, it is not a serious matter, and if these two extremes be avoided, quite good results are obtainable over a considerable range between them (Fig. 5 and Fig. 6).

I should say here that it is immaterial whether Step 7 precedes or follows Step 8.

9. The following ligamentous attachments of the calcaneus have now been cut: (*a*) the tibiocalcaneal fasciculus of the ankle on the medial side (this attachment disappeared with the removal of the sustentaculum tali); (*b*) the calcaneofibular band of the lateral ligament of the ankle; (*c*) the posterior talocalcaneal; (*d*) the lateral talocalcaneal; and (*e*) the medial talocalcaneal ligaments. The rest of the soft tissues at the sides and over the upper surface of the calcaneus have also been loosened from it. As a result, we have now succeeded in mobilizing the bone, and are prepared for the next step, which consists in pushing the calcaneus well for-

ward, so that the cut surfaces of the two bones can be fitted in close apposition. The anterior part of the calcaneus now protrudes from 1.5 to 2 centimeters in front of the head of the talus, instead of being, as at the beginning, about 0.5 centimeter behind it. In fitting, shave down with the osteotome wherever necessary, so that a perfectly adjusted close contact is everywhere obtained, with an ample advancement of the calcaneus. Also, now note carefully whether there is likely to be enough flap material to cover easily when the time comes for removal of excessive projection of the forward part of the calcaneus. If the flap material seems too scanty, then the operation will have to be modified by a more radical removal of bone from the calcaneus, making the section more horizontal and more ample in its scope. If there is still any doubt, proceed at once to trim down the anterior projection of the calcaneus and test the covering power of the flaps. Otherwise, it is usually more convenient not to trim down the projection until after the wiring has been accomplished.

10. Now take up the drill and bore a hole horizontally from side to side through the neck of the talus. The bore across the neck should be just behind the head and fairly high up, beneath the attachment of the anterior ligament of the ankle-joint, not low down near the surface of the cut. Leave a guide, such as a cannula, or a nail, in the bore-hole, and make a similar transverse bore in the calcaneus. To find the right place to make the bore, hold the calcaneus forward in the new position it is intended to retain, and bore across in a position below and a little behind the hole through the talus; the presence of the guide shows the location of this. The hole in the calcaneus must not be anterior. Put a temporary guide through the calcaneal perforation also.

11. Cut and trim the flaps to the exact shape and size desired. But in doing this leave the anterior tendons long, so that they can be sutured to the base of the lower flap.

12. Remove the tourniquet and attend to hæmostasis, using plenty of hot water.

13. Thread a length of stout silver wire, thick enough to have some stiffness (1 to 2 millimeters), through the bore-holes, make a final accurate adjustment of the two bones, and while holding them in position draw the wire ligature tight and twist up until the fragments are held quite firmly and immovably in the required position. The twisted ends are, of course, afterward carefully turned in toward the bone.

14. The anterior portion (greater process) of the calcaneus projects very prominently when the bone is held forward in its new and advanced position. If this projection be not trimmed down, a much longer plantar flap will be required than would otherwise be sufficient, and, after healing, the comparatively sharp and narrow hard projection in front of the rest of the stump may perhaps invite trouble and discomfort. The projecting part should therefore be trimmed down to an appropriate extent and bevelled off to a rounded contour. Be particularly careful to bevel away any sharp edge at the antero-inferior angle. The gouge forceps form a convenient trimming instrument.

15. Suture the anterior tendons to the lower flap in front of the calcaneus, as low down as possible.

16. Close the wound, putting a short and sufficiently wide tube at each side, to provide for oozing. These tubes should be removed within 36 hours. It would be well to elevate the limb by a swing, or on a cushion, for about the same period, or longer. (Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10).

MODIFICATIONS IN TECHNIQUE

In describing the steps of the operation, I have already mentioned some possible modifications of the technique. For instance, I have mentioned the effect of altering the plane of section of the calcaneus. Perhaps I should add to the list of warning notices. I have tried to do without wiring. But it was found that when the wire ligature was omitted, the calcaneus sagged and fell away from close contact with the talus. I tried to see if bandaging would control this, but repeated X-ray examinations of such cases showed that bandaging was useless, and, in any case, tight bandaging would not be permissible on such a stump. I tried thin wire,

and I tried a strip of the patient's own tendon, instead of thick wire, but I found it was a decided advantage to have some stiffness in the ligature, and only thick wire provided this. I also tried wiring from the front in an anteroposterior or sagittal plane, instead of transversely, but it was not very satisfactory. In my earlier work I cut the tendo achillis, but I now think it is far better to leave it intact, because it helps to keep the posterior part of the calcaneus well up in apposition with the talus, supplementing the action of the ligature. It seems to me, after some practical experience, a harder problem to ensure close apposition of the cut surfaces of bone posteriorly than it is to maintain the calcaneus in a fully advanced position. Another modification of technique that I have tried, and condemned, was to make an incision behind, adjacent to the tendo achillis, and after using the rugine, to introduce the osteotome and cut the top of the calcaneus horizontally from behind forward, instead of from before backward. I tried this several times, both with and without section of the tendon, but I cannot recommend it any way. I thought the posterior incision might come in usefully for drainage, but it does not seem to be required, and incisions in that situation have some special disadvantages.

I have already mentioned two operations carried out on the living patient before I had begun experimental work on the cadaver and worked out the best technique. But since this has been done, I have had an opportunity of testing on a living patient the fully developed operative scheme that I have described in such detail as the method to be advised and followed.

The patient, a young man, W. A. K., age 27, was operated upon July 10, 1916. He had been employed on railway construction work, and his foot had been crushed by a falling rail some time before. He had a healed, cicatrized deformity of the front of the foot, and being quite unable to walk, he was sent into hospital for amputation. Instead of performing a Syme or a subastragaloid, which would otherwise have been the only practical alternatives, I did the operation described above. The result has been everything that the most sanguine expectation could have wished for. The stump, of course, looks very like that of a successful Chopart. Roentgenograms show that the remnants of the talus and calcaneus have preserved their new relationship, and are united to form one bone. The backward projection of the calcaneus existing in the normal foot, which is the weak spot of a Chopart, has been reduced until it is now quite small; and the heel pad is brought forward, so that the weight is transmitted more directly through it. While the mechanical advantage of leverage possessed by the tendo achillis has been practically abolished by the shortening of the arm of the lever, yet the knee-flexing function of the gastrocnemius is unimpaired, since the tendon is intact. Ankle action is free, the calcaneal pad is horizontal and ample in amount, and walking is easy and comfortable. (Figs. 11, 12, 13 and 14.)

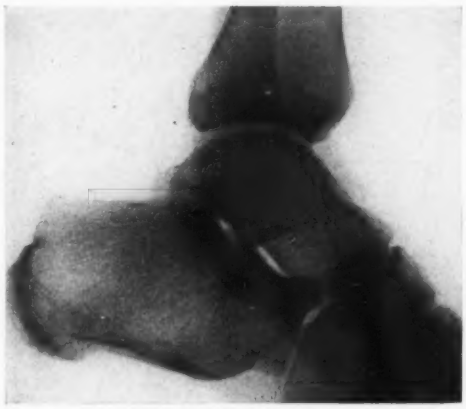


Fig. 1. Side view of bones of tarsus in a normal foot. Note the extent of backward projection of the calcaneus (posterior arm of lever), as compared with that remaining after operations No. 1, No. 2 or No. 3. Note also how, in the normal foot, the forward set of the talus in relation to the calcaneus is such that the head of the talus projects beyond the greater process of the calcaneus. The distance is approximately 0.5 centimeters in the male foot. In operation No. 1 the calcaneus is slid forward beneath the talus until the extremity of the greater process projects some 2 centimeters in front of the head of the talus. In No. 2 and No. 3 it is slid forward beneath the tibia. The figure shows also the normal slope of the long axis of the calcaneus from behind upward. The roentgenogram was taken with the patient lying down and the foot in a position of extension, as is shown by the angle shown with the tibia.

We may now consider what seem to be the good points of the operation which has been described. The result obtained in the case of W. A. K. sufficiently demonstrates that it is an operation well worth doing if the condition of the foot permits, especially as it leaves the way open for other less conservative operations without prejudice to their success. It could be turned into a sub-

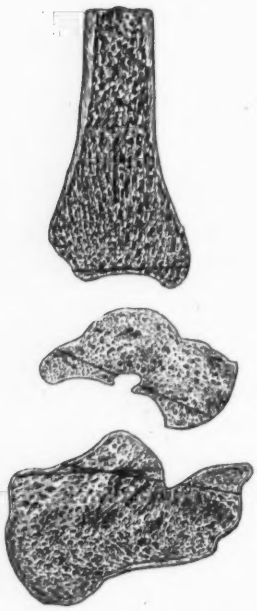


Fig. 2. Drawings of sections of tibia, talus and calcaneus. In the lower two bones the front end is to the right, in the tibia the front faces the left. The calcaneus and talus are cut vertically along a plane traversing the long axis of each. That of the tibia is anteroposterior and midway between the malleoli. The illustration shows the bones set at about their normal inclination.

Tibia. Note the straight line drawn across the bottom of the bone. This indicates the plane of section made from front to back between the malleoli in operation No. 2. The plane of section in No. 3 operation cuts off the malleoli also, and lies at a somewhat higher level.

Talus. A straight line is shown on the talus, indicating approximately the plane of section recommended in operation No. 1. Note that the cut begins rather low down on the articular surface of the head, and that the plane slopes upward and backward, being interrupted by the groove for the interosseous ligament. The section avoids injuring the ankle-joint or the posterior ligament, but shaves off all the articular surface beneath the bone with its irregularities.

Calcaneus. Note the normal upward and forward inclination of the long axis of the bone. Note the promontory on the greater process, which is removed to give freedom of access to deeper parts of the field of operation. Note the straight lines ruled across the drawing, to show the planes of section employed. One plane, interrupted by the groove of attachment of the interosseous ligament, slopes upward and backward from the anterior extremity to a point on the saddle-shaped upper surface, behind the prominent hump indicating the convex articular surface. Another plane slopes from just above the groove to a point at the upper limit of the posterior surface. Note that this plane also slopes upward and backward in relation to the long axis of the calcaneus, but is level with the horizon. This latter slope is that recommended as best for operations No. 2 and No. 3, though the former slope is allowable (see Figures 20, 21 and 22). The longer slope (interrupted line) is intended for operation No. 1, steepest allowable gradient. A slope cut less steep and reaching back to the summit of the posterior surface gives the furthest-back limit for the plane that can be recommended (see Figures 5, 6, and 7).

astragaloid, or into a Syme, or into my No. 2 or No. 3 operation, to be described later, without any particular difficulty, and the substitution could be either immediate or deferred.

In every case of amputation, one of the strongest desires of the patient and of his friends, as well as of the surgeon, is that as little should be sacrificed as is consistent with future comfort and physical ability. The operation I have devised certainly helps to satisfy this very natural desire, and there can be no doubt as to what the patient would choose if the conditions make the attempt justifiable.

If we except Chopart's as no longer justifiable, I think it may be claimed for the new operation that there is less trauma of soft tissues and less interference with blood supply than in any of the procedures—Syme, Pirogoff, Le Fort, Tripier, or the subastragaloid operation, for which it is a possible substitute. And to the surgeon of ordinary experience, it is, on the whole, quite as easy to perform as these other operations, easier, indeed, than some of them. At the same time, not one of them can justly be described as very easy. They all require skill and care.

It may also certainly be claimed for this operation that in the case of children there is no danger of interfering with the growth of the limb by injury to the lower epiphysis of the tibia and fibula.

In further comparison with Syme's operation, it will be noticed that there is very much less actual shortening. I have not actually measured it, but the difference in length is evident.

Another difference is that a flexible ankle-joint is preserved, giving more elasticity to the stump, a factor in lessening the jar to the limb during walking.

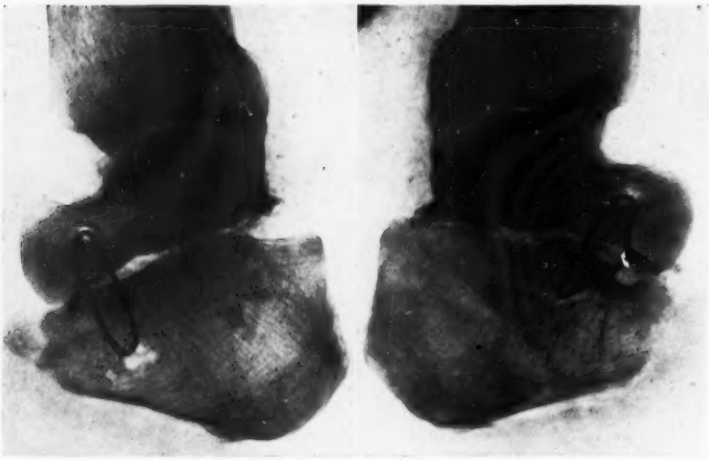
The existence of the ankle-joint has another effect. It allows of the pivoting of the leg on the calcaneus, so as to distribute the

Figs. 3 and 4. Operation No. 1: two roentgenograms from experimental series. It is seen that the plane cut surfaces on the calcaneus and talus, respectively, are brought into apposition and held in place by a wire ligature which is drawn through horizontal drill-holes above and below parallel to the plane of the cut surface. The denser shadow, looking like a "core" in the central part of the talus is produced by the shadow of the head and neck of the bone. It will be seen that the wire passes through this shaded part and not through the lighter peripheral part which belongs to the body of the bone.

weight evenly along the whole anteroposterior length of the part intended to serve as the tread. The mechanism is exactly the same as that provided for the "feet" of a tractor wheel built on the pedrail principle, and the function is also exactly similar.

The malleoli remain also. Their retention leaves a natural prominence on either side which gives opportunity for utilization both as vertical and horizontal bearing-points. The presence of vertical bearing-points is useful to the maker and wearer of artificial limbs because they make it impossible for the stump to work up and down inside the appliance after it had been laced on. This tends to add security to the limb, and strength and ease to the walking power. As horizontal bearing-points, they provide a comfortable and efficient means of taking twisting strains in an artificial limb. But as to this, there will be different attitudes among makers, according to the particular style of prosthetic appliance they sell. The makers of one very good type of these limbs say that it is a great advantage to have the malleoli to take up twisting strains. Another maker claims that the limbs he supplies never show any tendency to twist, the strains being sufficiently taken up by the grip of the apparatus when firmly laced on the leg, or leg and thigh.

However, apart from artificial limbs, there is yet another useful function that can be provided by the existence of a large-sized extremity to the stump and the prominence of the malleoli. It makes the stump very much more convenient for a man of the poorer class who cannot afford an artificial limb and who wishes to get about with the much less expensive substitute, a short boot. The boot is laced up above the ankle, and it can thus be firmly held to the stump without any slipping up and down, and without any twisting. The wearer of such a boot is given an additional advantage in the circumstance that the limb he possesses is of the most convenient length for the purpose. Of course,



Figs. 5 and 6. Operation No. 1. Two side-view roentgenograms from experimental series. They illustrate the proper plane of section of the talus, and show two examples of planes cutting the calcaneus, one reaching on to the saddle-shaped surface, a little behind the convex articular facet, the other extending as far back as the posterior end of the superior surface. Both of them, or any plane between them, will give a satisfactory result.

a boot is likely to be but a poor substitute for a good artificial limb; but these cost money.

But there can be no doubt that one of the most important advantages which the new operation provides is the surpassingly good tread. In all low amputations the tread is a matter of extreme importance. In this operation, and also in the No. 2 and No. 3 operations, the natural calcaneal pad is preserved on the weight-bearing area, and in its natural condition. After Pirogoff's or Hancock's operation, the patient treads on what was formerly the back of the heel, a part not naturally adapted for the purpose. In Tripier's and the subastragaloid amputations, as well as in a Syme, the calcaneal pad is dissected off its natural seating and replaced as a flap on another seat. This treatment causes more or less wasting of the pad from absorption. The calcaneal pad is a specially constructed arrangement of the tissues adapted to serve the function of a sort of weight-bearing and shock-receiving organ for the tread of the foot. It must therefore be a great advantage, other things being equal, to be able to preserve this pad intact for its original purpose. My operation not only contrives this, but the area of the bearing surface is much larger, both transversely and in an anteroposterior direction, than it is in any of the others, Le Fort's and Chopart's excepted. The two latter provide about the same as mine (Fig. 14).

Chopart's amputation has fallen into disrepute because it was so often followed by a non-weight-bearing stump. In the classical Chopart's operation, all that is done is to disarticulate through the mid-tarsal joint and cover the front with an upper and lower flap. Later on, the Achilles tendon very frequently succeeded in pulling up the back of the *calcaneus*, tilting it into a nearly perpendicular position, with the sharp lower edge of the greater process projecting downward like a knife-edge, and causing tenderness on the spot where the weight was borne. At the same time, the strong interosseous ligament pulled the head of the talus into a condition of downward flexion, carrying the cicatrix with it. In its new position the cicatrix had to transmit weight and carry thrusts, and cicatricial tissue is not adapted for that purpose. This tilting appears to have occurred even when the Achilles tendon had been cut. In other cases the calcaneus gradually rotated on an anteroposterior horizontal axis and

Fig. 7 Fig. 8 Fig. 9 Fig. 10

Fig. 7. Operation No. 1, bone preparation, seen from the medial aspect. This should be carefully compared with the roentgenogram of a normal foot shown in Figure 1. The comparison shows clearly the radical alteration in the leverage power of the Achilles tendon, which must be produced by the new and very greatly advanced relative position of the calcaneus. In this specimen the cut made on the calcaneus has reached as far back as the top of the smooth area on the posterior surface. The calcaneus has been slid forward until there is hardly any backward projection. A smaller degree of advancement (see roentgenograms, Figures 5 and 6) seems to give quite a satisfactory result. Note the position and the slope of the planes cut on the talus and calcaneus; the relative direction of the slope can be seen by comparison with the roentgenogram of the normal foot. Note that the upward and backward slope of the talus should not be carried up into the ankle-joint, but should be approximately as shown. Note the position of the wire ligature and of the boreholes. Note that there is still some projection of the anterior part of the calcaneus although it is seen that the greater process has been trimmed away.

Figs. 8 and 9. Operation No. 1, bone preparations. Front view of a right foot specimen, fibula removed, and of a left foot specimen with fibula in place. Note that the lower part of the head of the talus has been sliced off by a side-to-side cut, and that the corresponding plane surfaces on the calcaneus and the talus are accurately adjusted, and firmly held together by a stout wire ligature. The wire is seen to pass transversely through the neck of the talus, behind the head, but in front of the body of the bone, the ankle-joint being undisturbed. The vertical distance of the boreholes from the cut surfaces of the bones can be seen. The rough area on the front of the calcaneus is produced by the surface of cancellous tissue left after trimming away most of the greater process to reduce the anterior projection of the bone. Note that in this and in all the operations the sustentaculum tali has been removed flush with the side of the calcaneus.

Fig. 10. Operation No. 1, bone preparation, posterior view. At the bottom note profile of tubercles marking site of the natural calcaneal tread. The rough part above this corresponds with the insertion of the Achilles tendon, and above this is the smooth area on the posterior surface corresponding with the bursa, which lies here between tendon and bone. Then, above this transversely, can be traced the line of apposition between the cut surface of the calcaneus and that of the talus. It will be seen that the ankle-joint is unaffected, and a portion of the trochlear articular surface of the talus can be seen just beneath the tibia. A portion of the wire ligature can be seen, though rather dimly, on the left of the calcaneus.

assumed a varus position, causing the patient to walk on the outer side of the stump extremity.

A NEW PRINCIPLE

Now, I have in this operation introduced an entirely new principle. My idea is to push forward the calcaneus so as to shorten the posterior arm of the lever, and thus to lessen the mechanical advantage conferred on the Achilles tendon, and thereby prevent the tilting up of the calcaneus which occurs after Chopart's amputation. The anterior arm of the lever gets a little extra assistance from new attachments of the anterior tendons. Even if bony union of the talus and calcaneus did not occur, the area of fibrous union would be broad enough to give considerable strength. The lessening of the mechanical advantage of the Achilles tendon would be secured permanently.

As regards any propensity to horizontal rotation of the calcaneus on an anteroposterior axis, producing varus deformity, I think we can look forward with confidence to the elimination of any such tendency. In the first place, the lessening of the vertical diam-

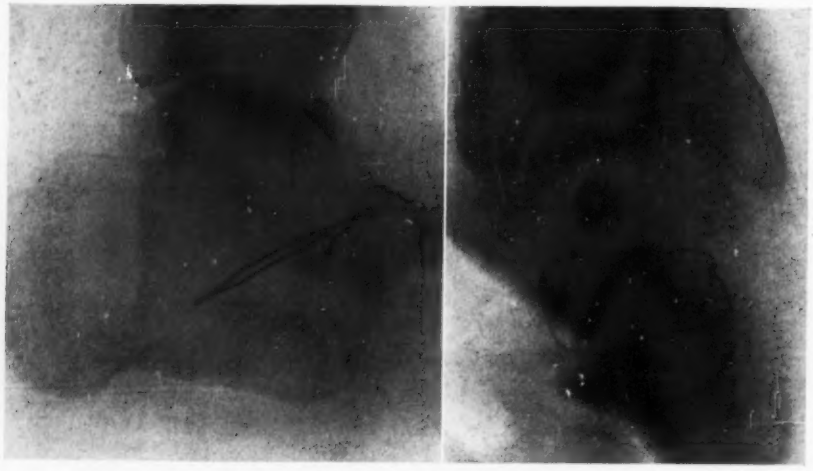


Fig. 11. (at left). Operation No. 1. Roentgenogram of foot of W. A. K., side view.
Fig. 12. Operation No. 1. Roentgenogram of foot of W. A. K., anteroposterior view.

eter of the bone makes it broader in proportion to its vertical depth than it was before, thus tending to stabilize its equilibrium better. In the next place, the flattening of the opposing surfaces of the talus and calcaneus, even in the absence of bony union, makes the calcaneus keep its flat face upward to meet the pressure coming down through the similar face of the talus. The removal of the sustentaculum tali also eliminates a point of leverage which might be commanded by the tendon of the flexor longus hallucis.

Fig. 13

Fig. 13. Operation No. 1. Photograph of the amputation stump of W. A. K. referred to in the text, 21 months after operation. There is free ankle-joint action of flexion and extension. Note the preservation of normal calcaneal tread, the situation of the cicatrix and the large size of the stump. The position of the malleolus is also shown. Such a stump would afford a good grip to a boot laced on to it.

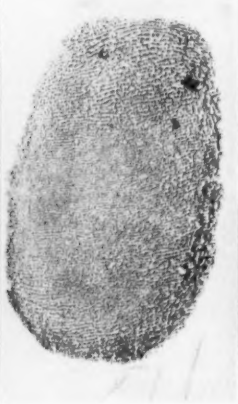


Fig. 14

Fig. 14. Operation No. 1, tread-point of stump of W. A. K., (reduced one-third). It shows the calcaneal tread unimpaired, and illustrates the large area over which the pressure is distributed.

Fig. 15

Fig. 15. Operation No. 3. Roentgenogram showing anteroposterior view. Same experiment as shown in Figure 16 and Figure 17.

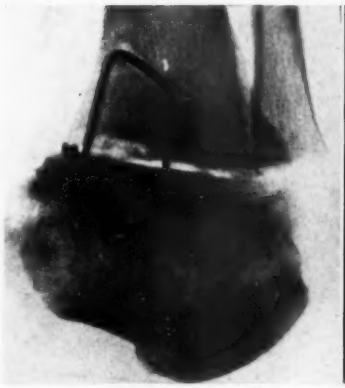


Fig. 16

Fig. 17

Fig. 18

Figs. 16 and 17. Operation No. 3. Figure 16 is a roentgenogram and Figure 17 is a photograph of the same cadaver experiment after making it into a bone preparation. Side view, fibular aspect, shows plane of section of tibia and fibula, and also of calcaneus. In the dry bone preparation it can be very clearly seen that the plane of section of the calcaneus in front takes off at the lower and anterior part of the rise of the convex articular facet, just behind the depression which receives the attachment of the interosseous ligament. The site of the depression is clearly shown. Note that the plane of section of the calcaneus does not correspond with the long axis of the bone, but has a slope relatively upward, so as to be level (i.e., parallel with the horizon) when set in position. This ensures that the natural tread of the heel shall remain the point of contact with the ground. Note that the advancement of the calcaneus brings the line of pressure within the perpendiculars of the tibia. Note the position of the transverse boreholes through the tibia and the calcaneus. It will be seen that the tibia is perforated comparatively high above the section, so as to obtain firmer bone. The anterior portion of the calcaneus has been very freely trimmed away.

Fig. 18. Operation No. 2. Roentgenogram giving anteroposterior view. Note the plane of section of the tibia between the malleoli. Note the method of ligaturing the calcaneus in position by a wire traversing the calcaneus from side to side and then passing out horizontally in the same direction through the bases of the malleoli. By pulling up the wire taut the calcaneus is brought up and secured in apposition, plane surface to plane surface, with the tibia. In this case the wire had not been pulled up quite tight enough to procure absolutely perfect apposition and it illustrates the desirability of attending to this point carefully. A wire that is too thin breaks if the tension exerted is very great, while one that is too thick is not pliable enough, and when pulled on may tear the bony tissue of the malleoli.

As further advantage over Chopart's operation, it may be mentioned that the sharp border of the calcaneus at the lower margin of the calcaneocuboid facet on the greater process has been taken away. And, finally, there is no projecting talus to be thrust against an overlying cicatrix.

In connection with the new operation it must be remembered that never again will the patient have to use his tendo achillis to rise on the toe pad in walking, running, or jumping. Therefore, the weakening of the muscular power of the back of the leg, produced by shortening the backward projection of the calcaneus, is no real loss, for the muscles of the calf will never again be called upon to do anything nearly equal to the work that was formerly required of them.

FURTHER EXPERIMENTAL STUDIES

In addition to developing the technique of the operation described in the foregoing pages, I have, since becoming interested in the subject, done a good deal of experimental work in connection with the type of osteoplastic amputation through the tarsus in which the talus has been eliminated altogether. The work has been quite worth the trouble, for two practical operations founded on the type have developed from the series. I shall refer to these as No. 2 and No. 3. Really, No. 3 was the earlier one to evolve itself, and No. 2 was an attempt to improve upon it where the other seemed to show weak points. I have not adopted a numeration based on seniority, but it is based on the order of conservation of bony structure. It is probable that in No. 2 a better operation than

Fig. 19 Fig. 20 Fig. 21 Fig. 22

Fig. 19. Operation No. 2, bone preparation, front view. The calcaneus is seen in position between the two malleoli with its upper, plane-cut surface in apposition with a similar plane surface cut on the tibia. The bones are held together by a wire ligature about 1 millimeter in diameter. This passes transversely through the calcaneus and then through the malleoli on either side in such a way that when the wire is drawn taut it pulls the calcaneus up firmly against the cut surface of the tibia. The wire is then brought forward and both ends are securely twisted up together in front, as seen in the photograph. On the right (medial) side the wire can be seen, though not very well, emerging from the calcaneus and passing up toward the deep aspect of the medial malleolus, whence it emerges after traversing it. The level of the take-on of the plane surface cut on the calcaneus can be clearly seen just below the wire across the front, and below this can be seen the shadow marking the sulcus which normally provides attachment for the interosseus ligament.

Figs. 20, 21, and 22. Operation No. 2, bone preparation. Three specimens showing side view on tibular aspect. In Figure 20 and Figure 21 the cut on the calcaneus has extended as far back as the upper limit of the posterior smooth surface. In Figure 22 the cut has ended posteriorly at a point anterior to this, on the saddle-shaped area of the upper surface, and the advancement of the calcaneus has been correspondingly less. Note in all the specimens how the upward and backward slope of the cut made on the calcaneus secures preservation of its natural tilt when the bone is brought forward and preserves the calcaneal tread in its natural position. Even in Figure 22 the tread comes directly beneath the line of the tibia. In Figures 20 and 21 the shortening and trimming of fibular malleolus is displayed very clearly.

No. 3 has been found; still, both have points of interest, and both are certainly operations for practical consideration. I shall, therefore, describe both, but I shall discuss the theoretical basis of technique chiefly in connection with No. 2, as I regard this one as the operation of choice. I shall, moreover, describe No. 2 after No. 3, but in spite of the seeming inversion of sequence it will be really more logical and convenient to adopt this order. The full discussion of the meaning of certain details common to both operations will not be found until they are met with later on under No. 2.

OPERATION NO. 3

The operation No. 3 proceeds as follows:

1. An upper and a lower flap are made, but shorter than in No. 1. It is difficult to give an arbitrary line, but one encircling the foot at the lateral plane corresponding to the prominence of the navicular bone is ample to mark the extreme anterior limit for the length of the plantar flap, and more than enough for the anterior flap. The damaged part of the foot is removed by disarticulation at the mediotarsal joint.

2. Then cut off the sustentaculum with an osteotome as in operation No. 1.

3. Next seize the head of the talus with lion forceps and carefully disarticulate it, cutting close to the bone to avoid injury to blood-vessels.

4. The next step is to remove a slice of the distal extremity of the tibia and the lateral malleolus at the same level as that prescribed for Syme's operation. But the osteotome is substituted for the saw in carrying this out. If a preliminary sulcus be cut round the bone as far as possible, by gradually deepening this the bone can easily be cut as cleanly

and evenly as by a saw, and just as safely, or more so. The osteotome is indeed the key which unlocks the problems of tarsal osteoplastic amputations, and I have found it not less suitable for knee-joint excisions. When one finds what can be done with its aid, it makes one marvel that its value for such purposes should not be better appreciated.

5. If an osteotome be employed, an operation preserving a segment of the calcaneus more or less like that of Le Fort's is easier to carry out than one such as a Syme, which requires resection of the whole bone. This discovery will be made at once by any experimentalist. In Le Fort's operation, the horizontal section of the calcaneus is made just below the level of the sustentaculum. It is far better to adopt a higher level. That of operation No. 1 will give a good workable result, but I recommend a section just a little different, taking off at the base of the convex articular facet about the bottom of the rise of the smooth articular surface. The calcaneus is broader here than it is at a lower level. The plane should not be parallel with the long axis of the calcaneus, but should have a moderate slope upward and backward, taking it up to the apex of the smooth surface, above the insertion of the tendo achillis, and then shaving it down until we procure a sufficiently broad cut surface to place beneath the cut on the distal extremity of the tibia (Fig. 2). The reason for the inclined plane will be discussed later. It is convenient, as a preliminary to shaving down the calcaneus, to remove first the projection of the upper and anterior portion of the greater process. Though massive cutting is satisfactory for the tibial extremity, as in Step 4. it is not to be recommended for the calcaneus, being less safe and under control than shaving. The surplus lengths of all cut tendons should be removed well back.

The reader will now be able to notice that we have contrived a bone section, of the tibia and fibula on the one hand, and of the calcaneus on the other hand, which is approximately the same as that adopted in Le Fort's operation, but it is brought about by an entirely different method. It is done more easily and simply, with very much less crude violence, with a much smaller skin incision, and with much less interference with the blood supply of the calcaneal fragment.

The next two steps are not paralleled in Le Fort's operation.

6. The calcaneal remnant is pushed well forward, and the surgeon decides how far the bone should be set in this position of advancement. It will probably be seen that the best position is one that leaves (in a male foot) from 2.5 to 3 centimeters projecting forward from the front of the tibia, the more the better, as this brings the deepest part of the bone, the natural tread, more directly in the line of pressure. Most of the projecting mass of bone will have to be cut back.

7. The greatest difficulty of the operation arises at the next step, when some method of keeping the calcaneus in close and fixed apposition with the tibia has to be contrived. It will be found that not only does the calcaneal fragment tend to fall away from the tibia, but the soft tissues tend to crowd in at the side and posteriorly. There is also some tendency for the fragment to rotate horizontally on an anteroposterior axis, so that it lies more or less on its side. These tendencies are more pronounced if the section of the bone has been parallel to its own long axis instead of sloped upward and backward to make it approximately parallel to the horizon. They are also more pronounced in a low cut section. There is another tendency to the assumption of a skewed position of the calcaneus, a rotation around a vertical axis.

The cancellous bone-tissue with which we are dealing is soft, and particularly so in patients who have been confined to bed and unable to use the foot for a considerable time, when one finds that it cuts like cheese. The surface over the cancellous portion of the tibia is almost without any compact crust, and what there is is very thin and unresisting.

Nailing the bones together is quite useless; I have tried it. I have also tried autogenous dowels cut from the individual's own fifth metatarsal bone, with equal want of success. I found the best thing to do was to get a very thick wire ligature, so thick that it would not readily cut the soft bone, and to hold up the calcaneus with it. It transfixes the anterior

portion of the tibia from side to side, well up, and loops through a transverse borehole in the calcaneus. This borehole through the calcaneus must not be too far forward. It is not always easy to draw the posterior part of the calcaneus up to the corresponding part of the tibia with the wire ligature, and prevent the crowding in of the soft tissues. This difficulty, when it occurs, is probably not so great in the living patient as it seems in the cadaver, for if the Achilles tendon is uncut, it will assist in holding up this end of the calcaneus. Hæmostasis is attended to before wiring is completed.

In connection with the difficulties of securing good and enduring apposition in tarsal osteoplastic amputations, I am not now surprised to note the statement made in the textbooks that, after Pirogoff's operation, bony union of the calcaneal fragment often fails to occur. If perfect apposition is difficult to get in the operation I have just been describing, it must be still more so in a Pirogoff, where no special means are employed for the purpose.

When flap material is scanty, the calcaneus can be pared down more and cut back further, until it becomes possible to complete an operation with an amount of flap not very greatly larger than that demanded by a Pirogoff (Figs. 15, 16, and 17).

OPERATION NO. 2

We come now to consideration of the operation which I have labeled as No. 2 of the series, though it is the last to be described. It was evolved as an attempt to improve on No. 3 by overcoming what seemed to me to be defects, and it expresses the result of quite a large amount of experimental work. After spending much time and much thought on the technique, I now feel able to recommend it very confidently.

It will, I hope, be sufficiently understood by the following description:

1. The remarks on incisions and flap material in connection with operation No. 3 apply also to No. 2.

2. The sustentaculum tali is removed just as in the other two operations.

3. The talus is removed, as in No. 3.

4. The soft tissues are separated from either side of the calcaneus. The most important part to clear is that immediately behind the site of the sustentaculum on the medial side, and the corresponding area on the lateral aspect. Further back, the separation need not extend far down the sides of the bone. The rugine is also used to separate the soft tissues from the saddle-shaped superior surface of the calcaneus behind the convex articular facet. The tendons severed in removal of the anterior part of the foot, and lying loose, adjacent to the side of the calcaneus, should be cut back also as far as conveniently possible. Then the remnant of the anterior ligament is cut away from the lip of the lower extremity of the tibia. Finally, the soft tissues are separated from the surface and borders of each malleolus, great care being exercised to avoid injury to vessels, nerves or skin, the cutting edge of knife, rugine, or osteotome being kept steadily close to and toward the bone.

5. It will be well now to remove the prominent upper and anterior part of the greater process of the calcaneus, so as to prepare for the easy performance of the next step, which is an important one.

6. We now have to make a plane surface on the upper aspect of the body of the calcaneus. This is destined to fit beneath a plane surface to be made on the distal extremity of the tibia, between the malleoli. We desire so to carry out the operation that, when it is finished, the natural heel-pad shall be preserved to constitute the tread of the stump. If the reader will recall to mind the anatomy of the undisturbed foot, he will recollect that in the normal state, the long axis of the calcaneus does not lie horizontally, but forms the posterior limb of an arch, and its general direction is one rising from behind forward. He will also recollect that the tread of the heel is at the base of this arch, and behind the plumb-line of the tibia. There will be no ankle-joint to pivot on and distribute stresses, and we must make an effort to get the tread as nearly as possible in the line of the tibia. This means advancing the tread, and we must at the same time keep the inclination of the calcaneus unaltered, so as to retain the same

heel-pad. To keep the calcaneus at its natural tilt it is manifest that if our plane surface is to be really level in relation to the horizon, it must be sloping to a moderate degree upward and backward in relation to the long axis of the bone. We can then slide the bone forward at its old inclination and so retain the original point of pressure. But to get this point approximately in line with the tibia, it will have to be pushed forward very considerably, so our section must extend as far back as is conveniently possible, that is, as far back as the posterior surface. And in order to get a broad enough section to give a good area for apposition with the tibia, it will be found necessary to take off rather more than just a superficial slice of the upper aspect of the calcaneus, behind the convex facet, since the saddle-shaped portion behind the facet is so narrow at the top. Different specimens of the os calcis vary so much that one cannot give precise instructions as to the amount of bone required to be removed (Fig. 2).

I recommend that no attempt should be made to remove the upper segment of the calcaneus in one piece, by massive cutting. The method looks attractive, but gives uncertain results. On the other hand, the shaving-down method gives complete command of results, and is easy. In this way we cut down first the prominence which marks the upper part of the convex articular facet. The osteotome then shaves back along the saddle, behind the prominence, until it reaches as far as the upper part of the smooth bursal area of posterior surface above the attachment of the Achilles tendon. At first, the plane surface is broad anteriorly, but very narrow behind. We go on shaving down the bone until a fairly broad surface exists along the whole area. The anterior margin of the plane of section has now reached a level corresponding roughly with the beginning of the rise of the convex articular facet, just beyond and above the sulcus accommodating the interosseous ligament (see the line of section shown in drawing, Figure 2). The line of section recommended for operation No. 1 will do, but the one here described is preferable. But the section should not be carried so low and so far back at its posterior end as the insertion of the Achilles tendon. If it were done, the surface of the bone corresponding to the insertion of the tendon would adhere to the tendon fibers, and it would probably also be comminuted. The surface layer should be allowed to remain, and the broken bits, if there are any, should not be forcibly dragged away, as they will continue to live, and may be useful sources of new bone. In an ordinary case there is really no need to manufacture technical difficulties by going thus low down with the back of the cut. We have to produce an upward and backward slope on the surface, and this slope, besides being correct theory, is much easier in technique than a cut made parallel to the long axis of the calcaneus, a fact anyone can prove for himself on the cadaver. The upward slope clears us from complications with the tendon, and it is also afterward more easily adjusted to the tibia. Indeed, some of my specimens show that really excellent results can be got even without reaching as far back as the posterior surface (Fig. 22). Such a simple operation is quite easy.

A plane horizontal surface has now to be formed on the distal extremity of the tibia, between the two malleoli. Cut away with the osteotome the anterior lip of the extremity. It is not necessary to avoid massive cuts on the tibial extremity as it is on the calcaneus. A vertical cut through the lip may be made on either side, and then a horizontal sulcus across joins them; this is gradually deepened, cutting the plane from before backward. The plane of the cut must be high enough to shave cleanly away the articular surface of the top of the concavity of the arch, or dome, and it should then be extended back until the posterior lip is also removed, extreme care being taken not to drive the osteotome into the soft tissues on the posterior aspect. The whole surface can then be dressed even by shaving. Care must be taken to preserve uninjured the compact articular surface layer of bone on the deep aspect of both malleoli. If this layer of hard bone be missing, the wire to be employed afterward will cut through the soft cancellous tissue which remains just as if it were cheese. The main purpose of the existence of the malleoli,

so far as this operation is concerned, is for the use that may be made of this hard and resistent layer of bone on either side.

8. If an attempt is now made to fit the cut surface on the calcaneus beneath that on the tibia, it will be found that the lateral malleolus is too thick and too long. The next step, therefore, consists in shearing off half or more of the downward-projecting length of the fibular malleolus, so that it shall not project any more than the medial malleolus. It is then carefully thinned and bevelled, to reduce its lateral thickness, particular attention being directed to the posterior portion, where it is thickest. Treat the soft parts always with respect. The covering is very thin over the prominent posterior border, where the bone is subcutaneous.

9. Now take the drill and make a horizontal drill-hole through each malleolus in a transverse direction. The drill-hole will not really be quite horizontal, and it is decidedly an advantage for it to slant a little upward, because the upward inclination makes an angle around which the wire ligature is to be drawn less acute, and therefore makes it easier to pull up and less apt to break. Begin each hole on the deep aspect of the malleolus, and make it pass through the hard articular lining as near the base of the malleolus as may be, and about midway between the anterior and posterior limits of the malleolus. Place a spatula, or similar flat instrument, between the superficial aspect of the malleolus and the soft tissues, so that the point of the drill, when it emerges, will not penetrate anything except the bone.

10. Next, make a trial fitting of the calcaneus to the tibia, plane surface to plane surface. Remember that we wish to bring the point of contact with the ground forward, as near as may be to the line of the tibia, and that the tilt of the calcaneus is intended to be so adjusted that the natural pad of the heel is to occupy the pressure-point as before. We shall, therefore, have to slide the calcaneal fragment forward to an approved situation, which must be marked, and if the slope of the cut is not correct enough, it can be altered by shaving off bone either from the tibial surface or from the calcaneal. By measurement and by marks we also note where a straight line joining the drill-holes in the malleoli would cross the calcaneus when fitted in the desired position. It is important to get this line correct, for on its correctness depends the registration, or alignment, of the calcaneus in the exact position intended by the surgeon, as shown at the trial adjustment. Having secured all the required information, we then make a side-to-side horizontal drill-hole through the calcaneus in the line that is to correspond with that between the two malleoli, and at a depth of about 6 or 7 millimeters (¼ inch) beneath the cut surface. The soft tissues are again protected with a spatula in the way already described.

11. It will be convenient to remove the tourniquet and attend to hæmostasis in the deeper parts of the operation area at this stage, before proceeding to wire the bones. In the meantime, a guide may be left in the calcaneal bore-hole.

The wire that is to be used for drawing the bones together and holding them in position must be strong enough to stand a fair amount of tension, and must be at the same time pliable. If too thin, it is apt to break. In my experiments I chiefly used copper wire of one millimeter diameter. This occasionally broke but anything much thicker was too stiff. I think silver wire not less than 1 millimeter nor more than 1.5 millimeters diameter would be the most suitable for operations on the living. I have never tried soft iron wire, highly recommended by Hey Groves for bone work.

Hæmostasis having now been attended to, a piece of wire some 20 centimeters (8 inches) or so in length is taken and threaded through the transverse borehole in the calcaneus. The free ends of the wire on either side are then passed through their respective malleoli, entering the boreholes on their deeper aspect and emerging superficially, the soft tissues being protected from injury meanwhile as when the drill was employed. The two ends are then drawn quite taut, while the calcaneus is carefully pushed into position. At the same time, the soft tissues at the back are pushed away by a suitable instrument, and prevented from intruding between the cut

surfaces of the calcaneus and tibia while the bones are being approximated. When the maneuvering has been completed and the wire is quite taut, the calcaneus is held firmly, closely, and immovably in accurate position. The wire ends are then brought forward across the front, twisted up securely together, and the points tucked in safely.

12. The anterior portion of the calcaneus now projects forward far beyond the lateral plane of the front of the tibia. This projection is now bitten down with gouge forceps, or otherwise removed, until it is reduced to a prominence of convenient size, or if flaps are rather scanty, it is made flush with the tibia. No sharp corners are left.

13. The flaps are now finally cut down to convenient size and shape if necessary, hæmostasis is secured, and the wound is closed. A wide drain should be left in for 36 hours.

As an appendix to step 11, I might say that in two cadaver operations I used slices of the individual's own flexor longus hallucis tendon as a ligature instead of wire. I did it in the following way: Before proceeding to amputate, the tendon was displayed by incision and dissection, its end detached from the toe, and it was then held out of harm's way while the amputation was done. Later on, when the sustentaculum and the talus had been removed, the tendon was cut proximally as far up as possible, close to the tibia. It was then carefully split by slicing along its whole length. A single length not being long enough, the two sliced ends were joined, to make it longer. The tendon was pulled through the drill holes by slipping backward through the holes a loop made by bending double a length of fine steel wire of the kind used for a nasal polypus snare. The wire was pushed through loop first, and when it appeared on the other side, the end of the tendon was placed in it and brought through by pulling up the wire. The drill holes need to be large, and probably thinner tendon would do. The tendon experiments seemed to be satisfactory. Possibly kangaroo tendon, chromic gut, or salmon gut would suffice if great care were taken to keep it taut when making the knot. But wire is an easier material to work with, and its stiffness, combined with pliability, which causes it to stay as put, retaining its curves, allows it to function additionally as a sort of splint as well as a ligature, which is another advantage.

Finally, in Operation No. 2, as in the others described, if flap tissue is scanty, the calcaneus can be still further cut down and cut back, and the malleoli can be shortened so as to be just sufficient to give a hold to the ligature by their articular surfaces (Figs. 18, 19, 20, 21, and 22).

NOTE.— I may add as a postscript that on March 30, 1919, I had an opportunity of performing operation No. 3 on the living subject. It was not a favorable-looking case to begin with, as there was so much destruction of skin that no suitable material existed for an upper flap, and also most of the covering of the lateral malleolus had to be cut away before bleeding could be obtained. Nevertheless, by using a surplus from the medial side, the lower flap was so maneuvered as to provide a sufficient cover, which was sutured sparely, and without a drainage tube. The wound healed forthwith without any suppuration, despite a thin and inconsiderable area of mummification at part of the edge. The final result promises to be as excellent for this case of operation No. 3 as was obtained with W. A. K., above described, when the No. 1 type of operation was employed. However, it will be wiser not to describe the case at any greater length here, but to wait until it can be reported with later experience.

DEPARTMENT OF TECHNIQUE

NEO-INSERTION OF THE ROUND LIGAMENTS

CABALLERO'S OPERATION

BY EDGAR NICHOLSON, M.D., BUENOS AIRES, ARGENTINE
Surgeon to the Rivadavia Hospital

AT the seventh Pan-American Congress of Medicine which assembled in San Francisco, California, in 1915, I presented a short report in which, in analyzing the different methods employed to correct retrodisplacement of the uterus, I tried to show the advantages which that of Doctor Jose Maria Caballero, my esteemed professor at the Rivadavia Hospital, offers.

As I have had since that time a considerable number of cases and as the end-results with this method have been excellent, I wish to call attention to the operation which is valued very highly in our country for I do not doubt that it will be considered favorably by many European and American surgeons. I will not discuss the various methods hitherto employed with which are connected such names as Doléris; Spinelli; Gilliam; Simpson; Kelly; Arce, of Buenos Aires; Spaeth; Wylie; Baldy; Dartigues; Jonnesco; etc., nor the reasons I have for preferring the technique of Dr. Caballero, as this point was covered in my former communication to the San Francisco Congress. However, I would emphasize that this article is written for no other purpose than to bring this procedure to the attention of foreign surgeons and, by reporting the good results obtained in our 1233 operations at the Rivadavia Hospital, to overcome any objection which may be made to it.

The procedure has been called by its author, "neo-insertion of the round ligaments." It is employed by us to correct only fixed or irreducible retrodisplacements or in those cases in which some other abdominal condition, such as disease of the adnexa, appendix, etc., has made necessary a laparotomy; since in the case of easily reduced retroversions or retroflexions in which the adnexa are in a healthy condition, we always practice the Alquie-Alexander-Adams operation, which without doubt produces the ideal result, both from the anatomical and physiological points of view.

For the steps in the technique, I quote from the article by Dr. Caballero published in 1913.[1]

Step 1. Median laparotomy with a small incision.

Step 2. Reduction of retroversion. If the retroversion is mobile, reduction is easy. If there are adhesions, they should be separated with care. In this step lesions of the adnexa must be treated conservatively.

Step 3. Withdrawal of the round ligaments through the incision and the creation of a musculo-aponeurotic canal. With a pair of Kocher's forceps, the round ligament is seized about 2 inches from its uterine insertion, and another pair of Kocher's forceps is introduced into the inferior portion, between the rectus muscle and its aponeurosis as far as the outer border of the rectal sheath, which is recognized by its resistance. Now raising the hand, the forceps are raised until vertical, while the other hand, exerting pressure on the abdominal wall, passes into the abdominal cavity. This perforation occurs very near the internal orifice of the inguinal canal. The forceps that have perforated the wall are now opened; the round ligament held by the other forceps is seized and the forceps closed. The ligaments are drawn through the canal already described, as far as the abdominal incision. The same technique is followed on the opposite side.

Step 4. Fixation or neo-insertion of the ligaments. Using No. 3 catgut the ligament loop is fixed to the aponeurosis of the rectus, on each side, about 5 millimeters from its border. One single stitch is sufficient to hold firmly.

Step 5. Suture. The abdominal wall is sutured in 3 layers, the two deeper layers with catgut and the skin with silkworm-gut.

As is evident this method is a modification of Doléris' technique. It is very much like the Gilliam operation. It does not present the

[1] Rev. de gynéc. et de chir. abd., Par., 1913, Nov. 5.

Fig. 1. Drawing showing author's technique.

dangers of the Doléris operation, however, and is incomparably more simple to do than the Gilliam operation. The real danger in the Doléris method lies in the possibility of the strangulation of an intestinal loop by the ligaments, an accident which cannot occur in the Caballero technique.

However, in the August, 1917, issue of SURGERY, GYNECOLOGY AND OBSTETRICS I find that Thomas J. Watkins, of Chicago, reports a case of intestinal obstruction following a Gilliam operation, the obstruction having been caused by one of the ligaments. I cannot understand how sufficient space could remain so that an intestinal loop could become obstructed if the operation were carefully done, since the instructions as to technique strongly emphasize the importance of introducing the Kocher forceps so that they will grasp the round ligament as near as possible the internal ring of the inguinal canal, and if possible so that they will pass through the ring itself. If this technique is strictly followed it would be practically impossible to leave sufficient space to cause internal trouble. At least we have never had such an accident in the Argentine Republic.

In France they have objected to Dr. Caballero's operation as one done blindly, exposing the operator to the danger of wounding the e igastric artery in passing the Kocher forceps ear the internal ring of the inguinal canal. As we know this artery at this level turns around the external edge of the rectus. The argument is not well founded as I cannot imagine how a vessel of the size of the epigastric could be injured with a blunt-pointed instrument such as the Kocher forceps. Besides it is not necessary to use any violence whatsoever to perforate the posterior sheath of the rectus muscle since at the level at which the operation is performed, the posterior sheath consists only of a thin layer and the peritoneum.

On the other hand this procedure should be controlled by the hand which has been introduced into the abdominal cavity. In this position the hand serves as a guide in indicating the exact spot at which we should make the perforation in the wall. In thin women it is possible to do this part of the operation under direct vision, since by raising the abdominal wall a little the internal ring of the inguinal canal can easily be seen.

Up to the present time I do not know of a case of retrodisplacement which has relapsed after the operation of neo-insertion. I have had the opportunity of observing many patients who have been operated upon and who have become pregnant many times, the pregnancies terminating in normal labors. Among our cases we have observed some in which the neo-insertion operation was done during the first months of pregnancy, and, with the exception of one or two cases of miscarriage as a consequence of the intervention itself, the pregnancy has gone on to term and labor has been normal.

In some patients it has been necessary to operate after neo-insertion for some other abdominal affection, and in such cases we were able to inspect the field of the neo-insertion and we have found that, in the area through which the round ligaments run, there has been formed a tunnel through which the ligaments slip with ease.

STATISTICS

Retroflexions or retroversions, mobile or adherent	648
Retrodisplacement complicated by some other abdominal affection (diseases of the appendix, adnexa, etc.)	420
Retrodisplacement and uterine prolapse (neo-insertion and vaginal plastics)	150
Retrodisplacement with vaginal and abdominal complications	15
Total	1233

Deaths, 4. Mortality 0.32 per cent.

In the statistics that I presented in my former communication in San Francisco, there was not a single death as the result of the operation. Here, unfortunately, I have to report fatal results in four cases, although in no case has the death been due directly to the neo-insertion itself; in fact the first three cases were suffering from grave adnexal complications, and died from peritonitis. The fourth case was an old woman upon whom was performed anterior colporrhaphy, colpoperineorrhaphy, and neo-insertion.

TECHNIQUE FOR BLOODLESS HYSTERECTOMY

By BERTHA VAN HOOSEN, M.D., Chicago
Acting Head of Obstetrics, Loyola University Medical School

HYSTERECTOMY has always been attended with a varying but certain percentage of fatalities and with more or less shock to the patient. The fatalities are largely due to secondary hæmorrhage and sepsis, the shock to hæmorrhage and to the direct traumatism of the sympathetic nervous system.

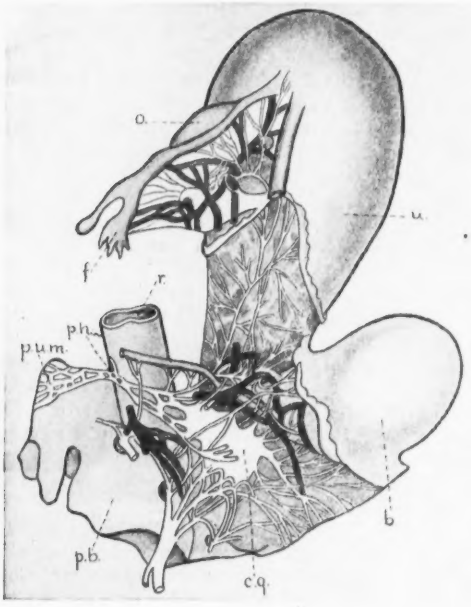


Fig. 1. Nervous ganglia of pregnant uterus (*Frankhaeuser*). *o*, Ovary; *u.*, uterus; *f*, fallopian tube; *r*, rectum; *p. u. m.*, plexus uterinus magnus; *p.h.*, plexus hypogastricus; *p. b.*, pelvic bone; *c.g.*, cervial ganglion; *b.*, bladder.

To avoid shock and to reduce the percentage of fatalities, the following operation for hysterectomy has been developed.

After the abdomen has been opened, the fundus of the uterus is grasped with a volsellum forceps and lifted well into the incision, or as high as possible. The assistant now maintains traction on the uterus while the operator places the index finger of the left hand under the round ligament and the thumb of the same hand under the ovarian ligament, at the same time retracting the broad ligament from the body of the uterus. With the right hand an eight inch forceps (preferably of the angiotribe pattern) is placed on the body of the uterus from a point opposite the internal os to the tubal attachment and the forceps is closed slowly enough to allow the uterine musculature to slip to the inner side. The forceps is closed lightly without using the racquet. Another forceps is placed in similar manner internal to this and touching it throughout its length. The side opposite is treated in the same way (Fig. 3). By this application of forceps we have pushed the uterine artery and the anastomotic branch of the uterine and ovarian artery away from the body of the uterus and the peritoneum covering the uterus is rendered tense and taut. The peritoneum over the uterus on both anterior and posterior surfaces is now incised, beginning one-half inch above the line where the peritoneum is intimately connected with the uterus and extending upward on each side parallel with the forceps and one-half inch internal to it (Fig. 3). The peritoneum adjacent to the forceps

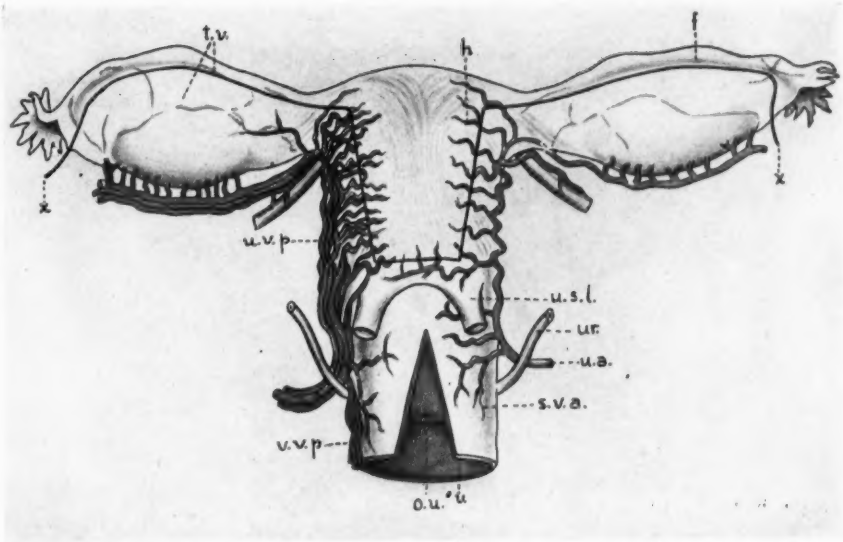


Fig. 2. *xx.*, Line of incision; *t.v.*, tubal vessels; *h.*, helicine branches; *f.*, fallopian tube; *u.v.p.*, uterine venous plexus; *v.v.p.*, vaginal venous plexus; *u.s.l.*, uterosacral ligament; *ur.*, ureter; *u.a.*, uterine artery; *s.v.a.*, superior vaginal arteries; *v.*, vagina cut open behind; *o.u.*, os uteri.

(*Technique for Bloodless Hysterectomy.— Bertha Van Hoosen.*)

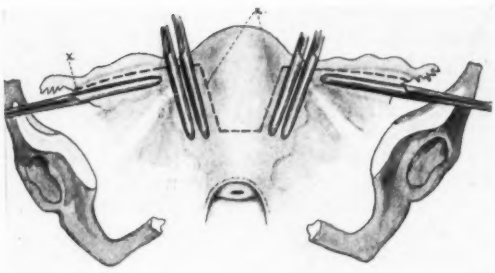


Fig. 3. Method of applying clamps. *x. x.* Line of incision.

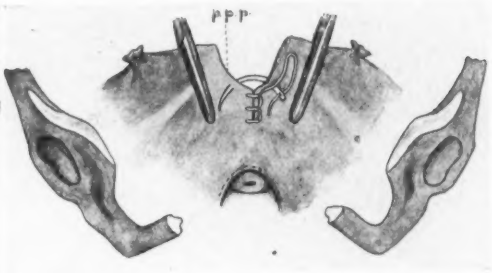


Fig. 5. Method No. 1. of closure of V incision. *p.p.p.* Posterior parametrium and peritoneum.

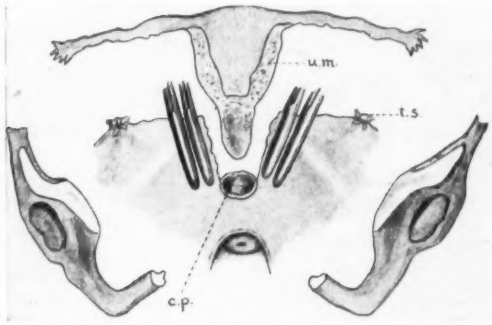


Fig. 4. Method of freeing the corpus uteri and coning out the cervix. *u.m.*, Uterine muscularis and mucosa; *t.s.*, tubal stump; *c.p.*, cervial pit.

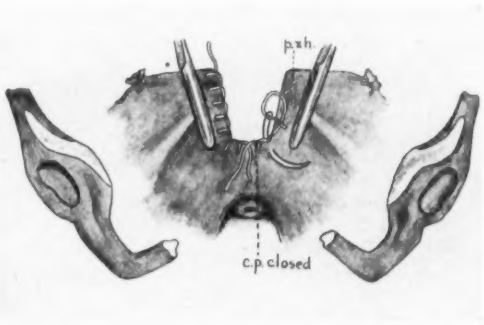


Fig. 6. Method No. 2 of closure of V incision. *c.p* cervical pit closed; *p.* and *h.*, parametrium and helicine branches.

on both anterior and posterior surface is lifted by undercutting with a sharp knife. Strong traction is now made in turn between the volsellum controlling and holding the body of the uterus and the forceps applied on each side and with a few strokes of the knife the uterine musculature is separated from the parametrium and the uterus is freed down to the internal os.

With dissecting scissors the cervical musculature and mucosa is coned out for any distance, even to the external os if so desired, and lifted out with the attached body of the uterus (Fig. 4). Neither ovarian nor uterine artery having been severed (Fig. 2), the suturing may now be begun. The first suture is placed deeply uniting the anterior and posterior border of the cervical cone. The internal forceps on the edge of the severed broad ligaments are now removed and the remaining forceps are drawn together and held until the cut edges on each side can be united with lock stitch the one to the other (Fig. 5). The lateral edges are united first from the posterior surface and after removal of the remaining forceps from the anterior surface.

If a generous border of peritoneum has been left there will be no surface uncovered by peritoneum except possibly at the tubal location. This can be better covered and at the same time the stump which represents a skeleton uterus can be elevated by passing a suture through each round ligament about one inch from the uterine attachment and by tying them together over the uterine skeleton (Fig. 7) and fixing them thereto.

Certain conditions may necessitate modifications or additional manipulations. If the fallopian tubes are to be removed, an eight inch angiotribe or strong forceps is placed on the broad ligament above the ovary and close to the tube and the tube is peeled out of its peritoneal covering and the cut edge of the peritoneum is ligated *en masse*, but not including the ovarian artery (Figs. 3 to 6). If the broad ligament has been distended by tumor growth, it may be impossible to push back the arteries by a single pair of for-

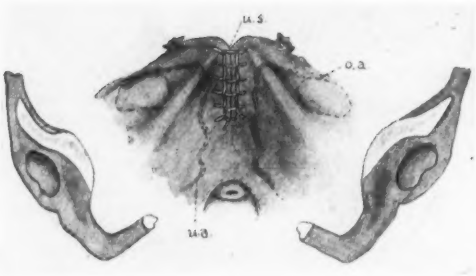


Fig. 7. Uterine skeleton with arterial supply undisturbed. *u.a.*, Uterine artery; *u.s.*, uterine skeleton; *o.a.* ovarian artery.

ceps, and in this case two or even three pairs may be used on one or both sides. In these cases it is often easier to whip over the edges of the broad ligament separately on each side with a lock stitch (Fig. 6), and later unite the sides with a running suture.

If there has been a prolapse of the uterus, the broad ligaments can be whipped over separately, as we suggested in cases of large tumors, and instead of uniting them one to the other each V-shaped portion of the broad ligament can be drawn up through the parietal peritoneum of the abdominal wall external to the border of the recti muscles and united over them in the central line.

ADVANTAGES

1. Preservation of integrity of entire pelvic circulation, especially of ovaries and ligaments.

2. The sympathetic nerves and ganglia about the uterus are not traumatized (Fig. 1), preventing shock and subsequent neurosis.

3. The position of the bladder and the ureters is undisturbed and they are not liable to traumatism.

4. The broad ligaments are left in their normal condition to maintain a division of the pelvis into anterior and posterior cavities, and to serve as a support to the small intestine when the patient assumes the standing position. In this way the patient is saved from the distressing symptom, backache.

5. This technique removes the chief causes of mortality following hysterectomy while bringing about other advantages; namely, freedom from neurosis, absence of backache, and, if the patient has not reached the menopause, preservation of the menstrual function.

The first series of one hundred hysterectomies done after this technique (fifty-seven at the Cook County Hospital and fifty-eight at the Mary Thompson Hospital) were without a mortality. Later series have been quite as satisfactory. Of the fifty-eight cases at the Mary Thompson Hospital sixteen had not yet reached the menopause and of these ten, or 63 per cent, are menstruating regularly.

This technique by its avoidance of trauma and with its low mortality ought to increase the indications for hysterectomy and to allow the surgeon to leave his patient much freer from pathology than if the usual classical technique were employed.

ELEPHANTIASIS OF THE SCROTUM

By L. NELSON BELL, M.D., Tsingkiangpu, China

ELEPHANTIASIS of the scrotum is met at times in all parts of the world, especially in tropical and semitropical regions, but there is a section in the northern part of Kiangsu province, China, with a latitude of southern Virginia and northern North Carolina, in which this condition is not at all rare. In the past few years 50 or more scrotums affected in this manner have been removed in this hospital by Dr. James B. Woods and the writer has removed several in the past two years.

That these cases are of filarial origin there has been little doubt and to a large extent they have come from localities not greatly separated. Some authors state the infection occurs through the drinking water and that after ingestion the filaria seems to have a predilection for the lymphatics of the genitalia and the lower abdomen. The writer has seen no cases affecting the genitalia of the woman but has seen a great number of cases of elephantiasis of the leg in both sexes.

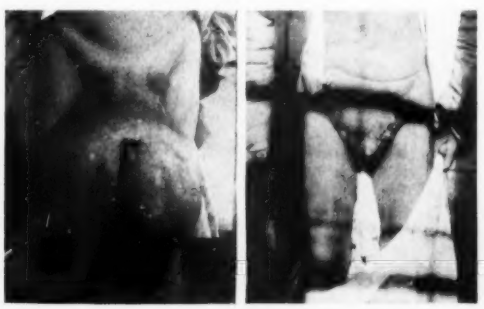
I will present two cases that have come under my observation in the past two months for any value they may be to others who meet this condition:

Case 1. Male, age 55, residence Si Yang. Family history negative. The present illness began ten years ago, at which time he noticed a slight induration of the skin of the scrotum. At that time he may have had a slight febrile reaction but he does not remember it unless it was confused with an attack of malaria. Since the time he first noticed condition the scrotum has enlarged progressively and at present is about the size of a large pumpkin. There has never been any pain and the only complaint now is discomfort on walking. The penis is completely enveloped in the tumor, the urine trickling out through an opening left as the prepuce was enveloped.

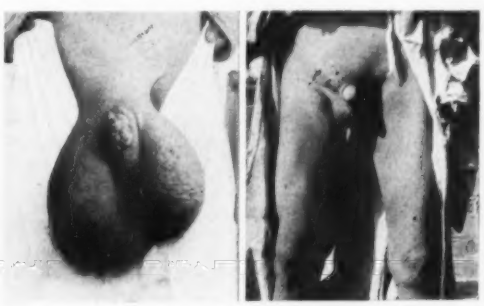
The patient was admitted to the hospital September 13, 1918. Physical examination disclosed a man of normal height and weight but complaining of impaired strength. The heart and lungs were negative. The urine was negative. The blood revealed decided malarial infection.

After admission, quinine was administered by the intravenous method. On September 17, the patient was operated on. He was put on table one hour before operation and the scrotum elevated to drain as much of fluids as possible.

Operative technique. The usual preliminary cleansing of skin is followed by the application of benzine-iodine solution and 3½ per cent iodine solution. A grooved director is passed up the fold leading from the penis and the point made prominent under the skin over the symphysis, and a curved knife is used to slit up this fold to this point. The penis is now opened to view in the bottom of the incision and is grasped with gauze and, after leaving sufficient of the mucous membrane, is dissected free up to the base of the arch of the symphysis and then wrapped in gauze and retracted up over the abdomen. All bleeding of consequence is stopped with hæmostats, the incision packed with hot damp gauze and the second step of the operation is taken up. This consists in making a longitudinal incision on either side and parallel with the original incision, and these incisions are deepened and lengthened according to the size of the tumor and the difficulty of finding the testicles. As one incises further into the tumor the consistency is less and less vascular and more transparent and serous.



Case 1. September 17, 1918, and October 16, 1918, after operation.



Case 2. October 3, 1918, and October 29, 1918, after operation.

It may be difficult to find the testicles, the best rule being to begin high and follow down into the scrotum. Usually one finds a hydrocele which is incised and evacuated. As the testicle and cord is freed, it is wrapped in warm gauze and pulled up over the abdomen, care being taken not to injure them by pressure or instrumental traumatism. The next step is to unite the upper ends of the three incisions by a straight transverse incision, and two elliptical incisions are made on either side of the tumor, uniting behind just in front of the anus. The remainder of the attachment of the tumor is then dissected close to the perineum and the tumor removed. After removal blood stasis is obtained and the testicles then placed on the perineum and the two flaps obtained by the two elliptical incisions form a close fitting sac in which they are contained. The mucous membrane of the penis is then sewed down to the upper angle of the wound and a dressing, in which a hole has been made for the head of the penis, is applied and retained in place with a T bandage. This bandage is changed as often as is necessary due to soiling.

The case I have just described made an uneventful recovery except that several of the stitches at the lower margin of the penis became infected and had to be removed. Recovery was rapid; October 16, patient discharged cured.

CASE 2. Male, age 48, residence Iu Geo (fifteen miles from home of Case 1). Family history negative. Present trouble began about ten years ago with loss of contractility of scrotal tissue followed by induration and a gradual enlargement since that time. The growth, however, has not been symmetrical, the right side being about four or five times the size of the left and the fold representing the site of the penis being the site of a number of small teat-like projections, somewhat presenting the appearance of a cauliflower growth but seemingly of fatty tissue. A constricting band was noticeable dividing the two sides of the scrotum. This patient complained only of the discomfort of the weight of the tumor in walking, but his general condition was not so good, there being a general sensation of weakness. The patient was admitted to the hospital September 26. Operation deferred to build up patient's general condition. All examinations were negative.

On October 3, the patient was operated on, the same technique being followed as in Case 1, except that the right side was incised through over half of its length and a rather difficult dissection was done on the inside of the tumor before the testicle was located.

This patient made an even more rapid and uneventful recovery than Case 1 and the end-result was such that the original condition could never have been guessed.

After blood and serum and lymph had drained from these tumors the one in Case 1 weighed 30 pounds and in Case 2,22 pounds. As to recurrence of this trouble after operation: The writer has seen one case of recurrence, the second tumor being about the size of a grape fruit. Removal was accomplished, but with difficulty, due to the scar tissue present. It is the general rule that they do not recur. Their weight is variable and has varied from 20 pounds to 60 pounds in this hospital.

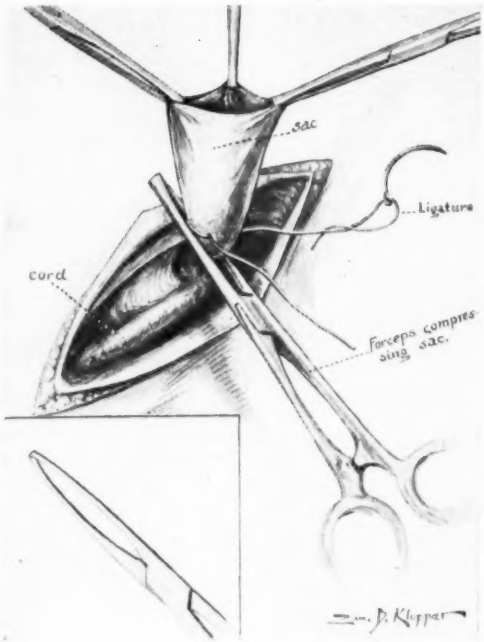
As to the operation itself, the technique may be modified to suit the case of the operator. Taylor, of Yangchow, has suggested a median incision through the entire tumor, the testicles being sought from the inner sides of the resulting halves. Others have suggested a complete circular incision around the root of the tumor, but it is the opinion of the writer that the above technique is preferable for the majority of cases.

The patients stand the operation well and we have never had serious complications with any of our cases.

The writer has also seen a number of cases of elephantiasis of the leg and has tried the Kondoleon operation with marked success.

TREATMENT OF THE SAC IN HERNIORRHAPHY

By A. MERRILL MILLER, M.D., F.A.C.S., Danville, Illinois



HIGH ligation and amputation of the hernial sac is a point in technique on which most surgeons are agreed.

To accomplish this various procedures have favor with different operators. To be certain the sac does not contain a loop of intestine or tag of omentum, the sac is usually opened widely and ligation made under the guidance of the eye. If a patient is straining or distention of the gut is present this may be difficult.

Any mechanical appliance which would add to the certainty and safety of high ligation, it seems, would be welcome. The Allis pick-up forceps is such an instrument, and is usually found in the ordinary operating set.

After its application around the sac the smooth spring blades are approximated until the peritoneal surfaces are in apposition. By firm pressure against the abdominal muscles a much higher ligation may be made than by the usual method.

FRACTURE OF THE NECK OF THE FEMUR IN THE FEEBLE

By WALTER D. WISE, M.D., F.A.C.S., Baltimore, Maryland

IN the past it has been largely the custom in treating fracture of the neck of the femur in the very aged and feeble, to treat the patient's general condition and more or less abandon the fracture. About 5 years ago, we began to treat impacted fractures of the femoral neck in the feeble by simply putting the patient on a Gatch bed in a modified Fowler position, supporting the thigh in the desired position as to abduction and rotation, by sand bags.

Later we added to this extension by applying adhesive to the flexed thigh, making the pull in the line of the thigh, leaving the flexed leg free.

The extremity is abducted as much as the width of the bed will allow or the patient will stand. If there is difficulty in maintaining the abduction, a modified Rainey splint or a simple rod spreader may be used.

A "dough-nut" pad is placed under the heel; the back rest may be raised or lowered as is desired.

The advantages of the above outlined method of treatment are:

1. It can be applied immediately after the injury, even while the patient is in shock, thus preventing a certain amount of shortening.

2. The patient sits in a comfortable position and is troubled by no apparatus such as a cast or splint, and thus it is possible to give more attention to the skin to prevent bed sores.

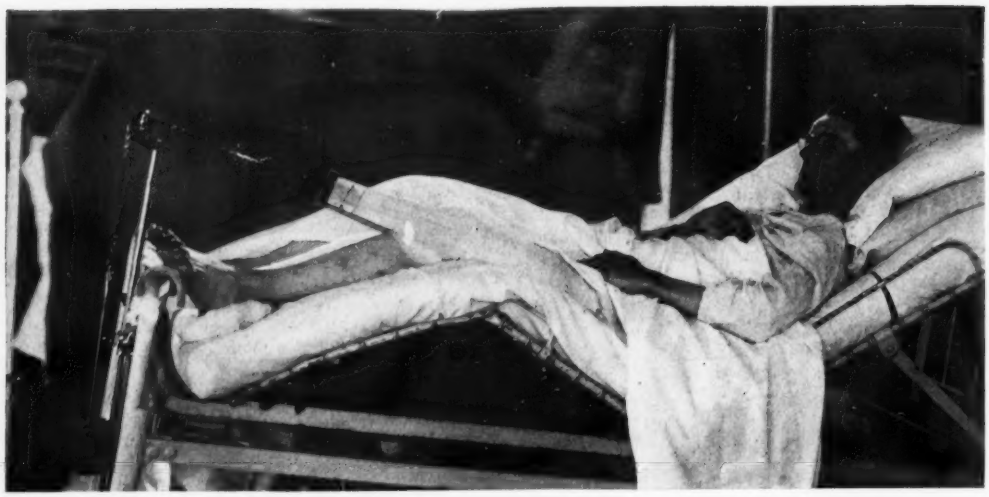


Fig. 1. Showing arrangement of extension, position of patient and pad under the heel.

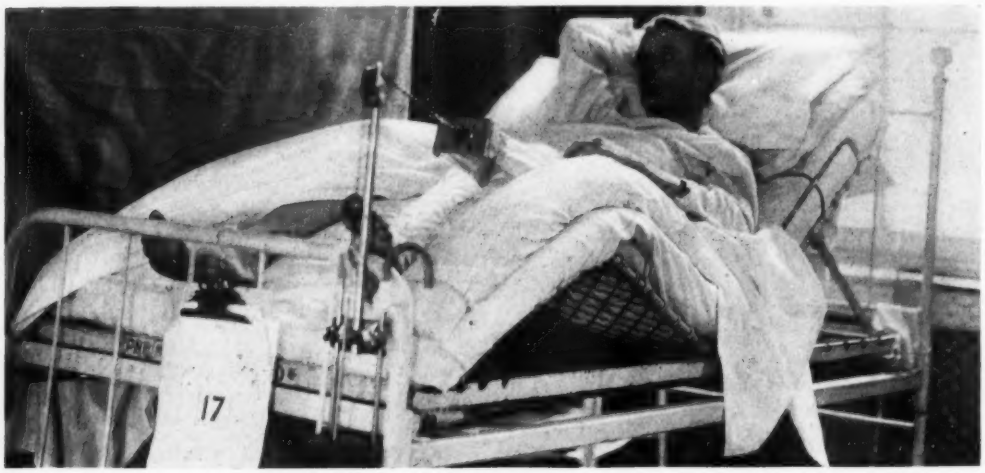


Fig. 2. Showing abduction to the limit of the width of the bed. Sandbags in place.

3. It provides continuous extension, no matter what position the patient assumes.

4. The immobilization is not complete enough to cause entire disuse of the muscles. In getting on and off the bed pan, in getting bathed and rubbed, there is enough exercise to keep the muscles in a fair state, and when the treatment is discontinued there is not the complete absence of power seen after many weeks spent in a cast or splint.

5. It is easy to get patient on and off bed pan.

6. It can be applied with little or no assistance and can be used in private homes.

7. It keeps the patient in a sitting position and guards against hypostatic congestion of the lungs and pneumonia.

CONGENITAL RADIO—ULNAR SYNOSTOSIS

By JAMES WARREN SEVER, M.D., Boston
From the Orthopedic Department, Children's Hospital.

THE recent report of two cases of congenital fusion of the upper end of the radius and ulnar by Feidt[1], and another by Kopelowitz[2], has led me to report a similar case which has been successfully operated upon. Feidt states that there have been about forty cases reported in the literature with but one case successfully operated upon and the result was obtained then only after five operations.

The condition is apparently an hereditary one, generally prone to occur in succeeding generations without any known cause from an embryological point of view. Feidt, quoting Lewis[3], states that "that at the sixth week of fœtal life the distal ends of the forearm bones were distinct and separated from each other, and that the perichondrium of the proximal end of the radius was continuous with that of the adjoining surface of the ulna." Lambertz's law relating to these cases is as follows:

"In the extremities, the ends which show a more elaborate development as regards shape have a less degree of growth, hence, as the radius does not develop in form it seems to increase in length." This embryological condition may therefore be carried over into full fœtal development in some cases, especially those with an atavistic tendency.

Clinically the cases present a bony fusion of the upper ends of the radius and ulna not involving the elbow-joint and resulting in a lack of ability to supinate. There is some ability to turn the palm of the hand up but only by means of outwardly rotating the humerus. No true power of true supination exists. The bony fusion may cover an area of 3.5 to 6 centimeters; in the case reported the distance was 3.5 centimeters. The radius is generally bowed somewhat as well as thickened.

Girl, age 8, appears normal upon general physical examination. The elbows show normal extension and flexion.

[1]Feidt. Congenital radio-ulnar synostosis. Surg., Gynec. & Obst., 1917, xxiv, 696-700.
[2]Kopelowitz. J. Am. M. Ass., lxxii, 21.
[3]Lewis. Am. J. Anat., 1901, 1.

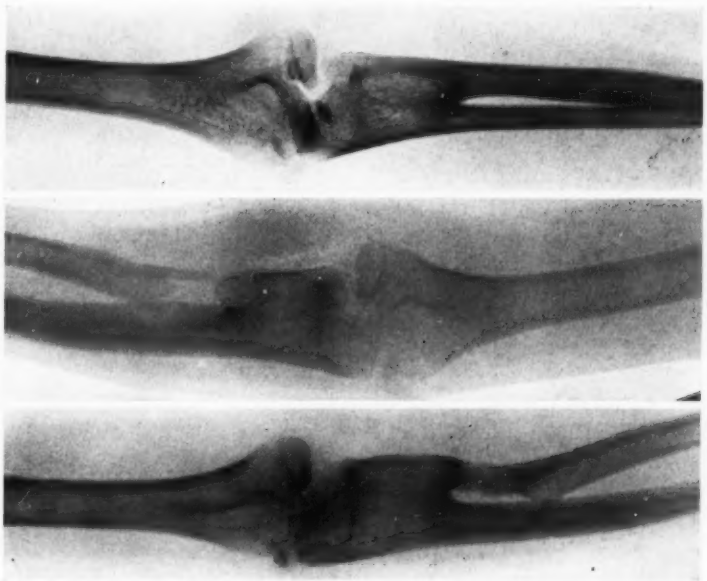


Fig. 1 (at top). Anteroposterior view of left arm before operation.
Fig. 2. Right arm after operation. Note beginning adhesion of radium to ulna.
Fig. 3. Note regenerated radius. Compare with Fig. 7.

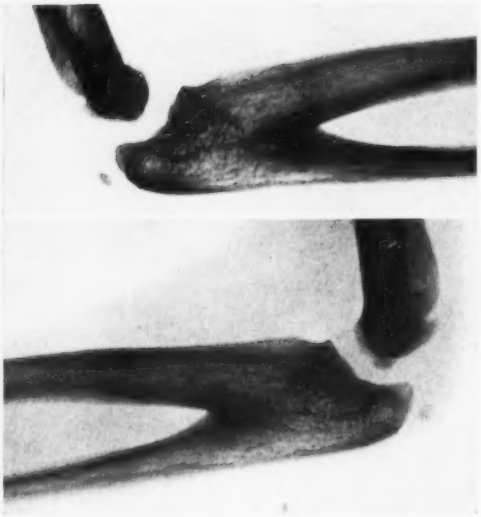


Fig. 4 (above). Lateral view of right arm before operation. Note fusion of radius and ulna at proximal ends.

Fig. 5. Lateral view, left arm. Note same condition as shown in Fig. 1.

Both forearms are fixed in 60 degrees pronation. The supinators are atrophied in both arms. The family history is negative. No similar cases are known in the family or among relatives. The patient was brought to the hospital

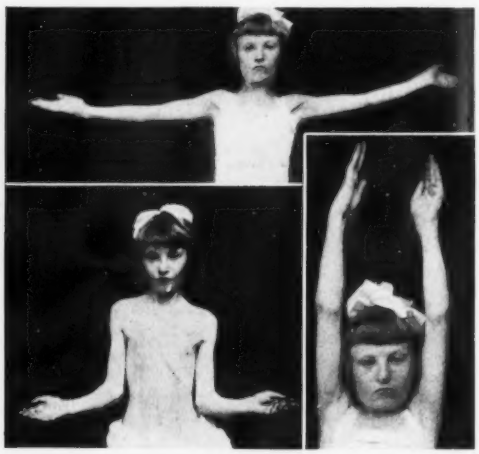


Fig. 6 (lower left). Photograph taken 21 months aft er operation showing ability to supinate.

Fig. 7 (above). Photograph taken 3 years after operation. Note supination and full extension at elbow.

Fig. 8 (lower right). Photograph taken 3 years after operation. Note supination.

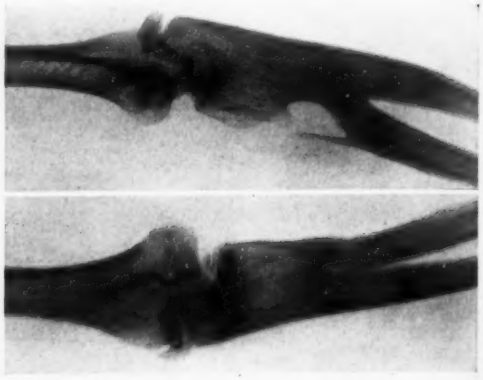


Fig. 9 (above). Roentgenogram of right arm taken 3 years after operation. Solid fusion of radius with ulna.

Fig. 10. Roentgenogram of left arm taken 3 years after operation. Note good result of operation. No fusion is present except with radius in corrected position.

on account of inability to supinate (see roentgenograms).

After study of the case it was decided to do an open osteotomy in the radius and to resect a piece about ½ inch long from each bone, putting the hand and arm up in full supination. On September 11, 1915, an incision 1½ inch long was made on the outer side of each forearm about 2 inches below the elbow-joint. About ½ inch of each radius was resected. The arms were put up in plaster casts fully supinated and kept so for six weeks. No attempt to divide the interosseous membrane or head of the radius was made.

The simplicity of this operation as contrasted with the more difficult procedures which involved the section of the head of the radius with the attempt to establish a new joint and which have led to poor results, is in its favor.

The child had a very rigid course of after-treatment in muscle training, exercises, and massage, all leading to the development of the forearm muscles, especially the supinators which were markedly atrophied from disuse. The roentgenograms show that on the right arm there occurred an adhesion between the distal end of the resected radius and the ulna in the new position, which, however, did not lead to any noticeable impairment of supination. Both arms were more useful. Full supination could easily be performed and pronation was, of course, accomplished by inward rotation of the humerus. The procedure is so simple that it is to be hoped that there may be an opportunity for others to try it out.

In concluding, I cannot emphasize too strongly the necessity for long continued after-care, consisting of muscle training, exercise and massage in order to insure a good functional result.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FRIDAY, APRIL 18, 1919, AT 8 P.M., DR. N. S. HEANEY PRESIDING

OCCURRENCE OF NEW-GROWTHS IN LAPAROTOMY WOUNDS

DR. W. C. DANFORTH: In the absence of Dr. Danforth, Dr. R. A. Scott read Dr. Danforth's paper on "New-Growths in Laparotomy Wounds" (see p. 175).

PREGNANCY AND LABOR FOLLOWING AMPUTATION OF THE CERVIX UTERI

DR. O. S. PAVLIK discussed the subject of pregnancy and labor following amputation of the cervix uteri (see p. 172).

DISCUSSION

DR. C. B. REED: When my case cited by Dr. Pavlik came before me it was extremely interesting to find how little literature existed on the subject. At that time I supposed the literature would be quite extensive on account of the frequency with which the operation had been done, but I called up several gynecologists here in town — Ries I think among them — and I could not find that any of them had ever seen a case of pregnancy after a Schroeder had been done. This would of course suggest that the sterility in these cases had been underestimated by the men who had reported the cases. I was also surprised to find after Dr. Pavlik has gone into the matter how little literature exists on the subject. It is an old operation and a common one, and it must be that pregnancy has followed or has complicated the conditions that followed the operation.

In my own case the woman went practically to term, but I do not know that that would be a common experience. The statistics do not seem to be very sure about it. My own feeling is that the operation of cæsarean section in these cases is justifiable on account of the rigidity of the cervix and on account of the danger of tears into and through the upper tissues of the pelvis. Therefore, I feel that the conclusions reached by Dr. Pavlik are very justifiable.

DR. R. W. HOLMES: It must be ten years since I planned to write a paper on this subject. At that time there was nothing in the literature. About sixteen or seventeen years ago when I became a member of the staff of Augustana Hospital Dr. Ochsner discussed with me amputation of the cervix in its relation to subsequent pregnancy and suggested that it would be interesting if we wrote it up together. At that time I looked up a number of our cases, and the only conclusion I came to was that the ear-marks of labor were lost. You could not tell anything about the labor because so much was lost in removal of the cervix. The labor was exceedingly easy and uneventful. At that time I decided that the paper I would write would be to contrast the benefits to be derived from amputation of the cervix with those from repair of the cervix. I think it is a real menace to repair a cervix in a woman who is going to have a baby. The circumference of the cervix is greatly reduced by an ordinary trachelorrhaphy. Therefore, if I thought it necessary to do anything to the cervix in a child-bearing woman, it should be an amputation and not a repair. I have said over and over again that the rarest abnormality to be found in obstetrics is a rigid cervix. There are sometimes other things that will cause rigidity, but when an analysis is made the cervix is found to be not the thing at fault, but that there is a minor pelvic contraction.

DR. GOLDSPOHN: I am rather surprised to hear of so many instances as the essayist reports of obstruction to labor from cicatricial development following this operation, and likewise in reducing the obstruction to conception. I would declare most emphatically that any such cicatricial development is obviously due to wrong technique, poor surgery, an imperfect plastic.

The only reason that I had in mind that might properly be regarded as an objection to amputation of the cervix was the one the essayist alluded to last, namely, that there might be insufficiency of retentive function in the pregnant uterus, which invited miscarriage. Now as far as experience goes, I should state that I have done a good many amputations of the cervix which were followed by pregnancy, and there must be a good many of my cases in this city. These cases afterward were mostly in the hands of assistants of mine, so not many of them were out of our reach. The obstetrical cases that followed our combined gynecological work showed that such cases do occur. I do not know that this operation is instrumental in producing abortion. It seems possible that it might produce a premature labor, but not so early that a living child might not be delivered. The internal os does not soften until about the last month of normal gestation. The external os will frequently soften up and

become patulous. You can put your finger into that little cup, but you strike the internal os. It is generally very near termination of labor before the internal os gives way and the entire cervix becomes a soft tube, which will soon relax, to be followed by labor. Now if that view of it is correct, the internal os holds firm until a time when there is no danger of the baby being delivered. Therefore, is it rational to assume that the cervix plays an important rôle in gestation? To my mind, it is not.

Now what is the reason for doing an amputation of the cervix rather than an ordinary Emmett plastic? If the cervix has simply a tear in it which does not extend up into the vaginal canal and the tissues are soft, normal, elastic, and pliable, without any induration, that lesion is not a pathological entity. It is simply a blemish that annoys the practiced eye that sees it. We may have a pathological induration, the outcome of previous infection and inflammation. We may have that without laceration, but we have it more frequently following laceration, because the laceration furnishes the atrium where the infection enters. Dr. Emmett had the correct idea, but I contend that he did not give a clear enough opinion of the achieved end. All he said was that by simply cutting out the pathological cervix with the tear, you removed only the irritation which came from that part. You did not remove the irritation which comes from the entire indurated trunk of that cervix, nor that which comes from the granulating and inflamed area above the cervix.

When we amputate these cervices, how far up should we go? In childbearing women I would not go more than half-way up to the internal os and would leave at least one-half inch. That will take away the tissues that are indurated and least endanger the chances of future childbirths. In doing this amputation of the lower half of the cervix we remove many of the cervical glands in which we find retention cysts in the graafian follicles. They are not in the cervix at the end of the os, but are found in the cervical tissues farther up. It is from these follicles that malignancy comes, so by removing these at least in the lower half of the cervix we take away more of the irritating element and much of the danger of a later malignancy. But correct surgery must be done and no denuded cysts should be left. Mucous membrane must meet mucous membrane and there must be a perfect plastic.

Dr. Paddock: The essayist said nothing about abortion which can occur in these cases previous to the operation. He laid particular stress upon pregnancy following the operation. I think Dr. Goldspohn emphasized, or at least meant to, that the infection which extended to the tissues which need repair has also extended to the endometrium and left it in such a condition that abortion is frequent. I think abortion is due more to that condition than to the result of the operation. Personally I cannot believe that the abortions which occur early are due to the amputation of the cervix. Amputation can produce premature labor when we have the lower uterine segment forming later in pregnancy, but how it can produce abortion, I cannot understand. I recall more than one case in my own practice — I am sorry I cannot give the statistics — where the cervix was amputated and there were none of the difficulties in labor mentioned here tonight. I want to emphasize that the condition which already exists, and not the operation, is what is responsible for the abortion.

Dr. Van Hoosen: I think Dr. Paddock would be interested in a case in which I performed a hysterectomy four weeks ago. The patient had had three children and had never had a miscarriage. After the birth of her third child she was told she had a lacerated cervix and was advised to have it repaired. After this she became pregnant, but never carried the child longer than two months and she lost so much blood that I decided on account of the operation she would probably not be able to have more children. On examining the uterus I found there was only an inch left. I never saw a patient with a uterus that had so little of the uterus remaining. An amputation must have been made above the internal os. I do not believe Dr. Paddock could expect a woman to carry a child to viability with a cervix that is amputated above the internal os. If half of the cervix is left, I do not think any one would expect a woman to have difficulty in labor, but if the amputation is higher up, I am sure it would interfere. About two years ago Dr. Yarros confined a patient who had a high amputation of the cervix. The woman went to full term and went into labor. I saw her with one or two other physicians in consultation. It was a very difficult labor and both mother and child died. Shortly after a doctor from Pittsburg told Dr. Yarros of a similar case in his service, in which the patient died from uncontrollable hæmorrhage.

Dr. Goldstine: I want to defend a statement Dr. Pavlik made. Personally, I have never seen many abnormalities from amputation of the cervix, because we do not run into many Schroeder operations. Where I have run into these, it has been with some other plastic work. Very little amputation is done by me because of two statements made by two past presidents of this society. The first man said that no good was accomplished by amputating the cervix in the presence of carcinoma. Since that statement was made I have left the cervix alone. The second statement was by a man who wanted to know why the scar from an amputation was not just as much of an etiologic factor in causing carcinoma as the original scar. I do not believe we can do very much amputating as a prophylactic measure, particularly against carcinoma. Recalling my experiences in the Dublin Hospital, I do not remember seeing a case where dystocia was caused from amputation or where a repaired cervix prevented abortion.

Dr. Ries: The very enjoyable discusson that was brought out by this paper seems to indicate

that there is a good deal to it. We hear on one side reports from the literature that amputation of the cervix is a very bad operation, and on the other side from the personal experience of one of our members we learn it is not bad at all. There is just the bare possibility that we are not always speaking of the same thing when we speak of amputation of the cervix. It has been stated in the very interesting reports in the literature exactly what kind of amputation was done. The Schroeder method is not the only method which is practiced. There are several others. I have had the pleasure of seeing Dr. Ochsner operate on the cervix only once and what he did was not the Schroeder operation. After the Ochsner operation I see no reason why there should be dystocia or a cicatricial cervix, whereas after the Schroeder operation there is another condition. I think the point brought out by Dr. Van Hoosen regarding the different cervical operations as to height is a good one. Of course, that will make an enormous difference in subsequent labors. If we speak only of amputation of the cervix and its influence on further pregnancy, we have to specify what height of operation we are speaking of.

DR. HEANEY: Amputation of the cervix is a different thing in the hands of different men. If we analyze Dr. Pavlik's paper we will find he has two sets of cases. That must be due to a difference in the kind of method. He made one statement which I do not think he meant, that Dr. Reed did the cæsarean section as he feared a premature termination of labor. That statement probably needs correction.

The effect upon labor depends upon the amount of cervical tissue that is left and the kind of scar resulting. I have had two patients that have had vaginal cæsarean sections done, but they failed to heal, so there was practically no cervix left. These patients frequently abort. They have bleeding without pain, and when a physician arrives he finds the ovum sticking out of the cervix. They have no pain, just the ordinary intermittent contraction. One patient who had an incision of the cervix for dysmenorrhœa and sterility, had a few little pains and then aborted. By passing a sound it was found that there was an incomplete ring to the cervix. We can imagine if the amputation is short, it would require a few more pains to dilate the cervix than it would in a patient who has had a vaginal cæsarean section with failure to heal, and that this patient would probably abort early. I have never confined a patient who has had a Schroeder operation. I have delivered a great many patients that had amputation of the cervix by the Martin method, a low operation with just a portion of the cervix removed. I recently delivered a patient for the second time. She had been married eleven years before she became pregnant. She had had a very severe leucorrhœa. The cervix had been dilated twice in order to do away with the cervical dystocia. I did a low amputation of the cervix, leaving half of the cervix. The patient very promptly became pregnant. I delivered her twice and operated on her within two years. In each one of the labors the first stage always was very short; two or three hours and the cervix was dilated, and not with very much difficulty because there was not very much tissue to overcome.

Now in Dr. Pavlik's paper he speaks about two sorts of conditions arising from cervical amputation. First, the patient has an amputation followed by a premature labor or she cannot carry the baby to term, or secondly, she has an obstruction to the cervix. They cannot be due to the same cause. The first one that had no healing in the amputated cervix was constantly aborting. In the other case she has scar tissue resulting and the cervix dilates with great difficulty. I have one patient on whom I did a Martin amputation of the cervix and if she ever becomes pregnant, she is going to have a hard time. She had a hæmorrhage on the second or third day and the interne took a wad of cotton, soaked it in ferric chloride and packed it in the vagina to stop the flow. It stopped the hæmorrhage but she had a slough and now there is a mass of scar tissue in the vault of the vagina. She menstruates without pain. I think the result upon pregnancy and labors as brought out by the various discussions depends first on the amount of tissue left in the cervix, and second, on the amount of scar.

DR. HOLMES: It just came to my mind that the expression "amputation of the cervix" gives a wrong idea, as suggested by Dr. Van Hoosen. Literally, amputation of the cervix means amputation of the entire cervix. Of course it does not mean that to the gynecologists. I have never done a complete amputation of the cervix except in old women with greatly dilated cervix and marked prolapse. Our gynecological method of cervical amputation never means amputation of the entire cervix. Ordinarily it means about one-half of the cervix.

DR. PAVLIK (closing): The point I wanted to bring out was this, that if there was poor repair and a great deal of cicatricial tissue, abortion would frequently result. According to the literature and according to the personal communications which I have received, it shows that about 50 per cent of these woman abort.

EXTRAPERITONEAL TUMOR COMPLICATING PREGNANCY

DR. VAN HOOSEN: The patient was a woman, 33 years of age, in her first pregnancy. She had asked me to confine her, but had not come to the office for examination. One day she telephoned that she was having terrific pain and was advised to come at once to the hospital. At examination I found a large mass in the posterior cul-de-sac, about the size of a very large orange I thought it was an incarcerated tumor. I called Dr. Yarros in consultation and she agreed that probably the best thing to do would be to wait until the child was

viable. We kept her free from pain and put her in bed in the knee-chest position. She had a great deal of pain all along and at the seventh month we decided to do a cæsarean section. I opened the abdominal cavity and found that the tumor was not in the pelvis at all, but entirely extraperitoneal. It had no connection with the uterus, ovaries or tubes as far as I could see. I closed the abdomen without doing a cæsarean section. At the same time, while she was under the anæsthetic, I put in a retractor and made an incision into the posterior vaginal wall and came upon what felt like a fibroid tumor. While I was trying to loosen the capsule, my finger went through into the cavity anteriorly, which was as smooth as glass and filled with a soft bran-like tissue. When I withdrew my finger this soft bran-like tissue poured out. In a few seconds I had enough material to fill a small pail. The hæmorrhage was so severe that it required five yards of half-inch width gauze to stop it. The patient was put back to bed. The packing was removed on the fourth day. The next day she gave birth through the vagina to a male child. It evidently had been dead for a day or two because the skin was pretty well off the scrotum. The patient lived for two weeks after the birth of the child. She did not have a high leucocyte count, or a very low one at any time.

Histological preparations of the tumor tissue are to be seen under the microscopes. Dr. Ries has studied these specimens and I hope will describe them to you.

DR. RIES: Through the kindness of Dr. Van Hoosen I have been allowed to see some of the tissue and some of the sections which you see here. The mass which I saw looked like a blood clot. There was no structure to be recognized. The tissue I received was about the size of a goose egg, and was only a small portion of what was removed. The sections which you see here were made in Dr. Lincoln's laboratory. They were characterized at first glance by two important facts, one is the hæmorrhage, which is throughout. There was an enormous amount of syncytial tissue. The arrangement of cells was much the same as you see in the normal placenta of a hydatid mole. Besides the syncytial cells there were many cells of different types. There was no structure that would remind one of the placenta, but that is not necessary for a diagnosis of syncytioma malignum. These tumors are characterized by irregular nuclei of decidual cells and Langhans' cells.

If we consider what other tumors should be considered as possibly giving rise to these tumors, we are reminded of the giant-celled sarcoma. They do not show these irregular growths of finger-like branches of syncytia such as we see under the microscope here. This growth of syncytia is quite typical of syncytioma originating in the placenta. One might think of a dermoid or a bone tumor, but bone-marrow tumors are always accompanied by other suggestions of bone marrow. You find there the cells that you find in bone marrow and there is nothing like that in this case. I am at a loss to think of any other origin of this tumor except the placenta. This would make the tumor one of those extremely rare malignant syncytiomata, which has occurred during pregnancy and has taken its origin in that pregnancy. It is not possible for the syncytioma to develop from a previous pregnancy although it is possible for a pregnancy to become superimposed on the syncytioma. I know of only two or three cases where the syncytioma has been found outside of the uterus during pregnancy. There have been a number of cases where the syncytioma has developed in the uterus or in the wall of the uterus during the course of the pregnancy. That is the type of the original cases of syncytioma described in the early days.

This is a very remarkable case. When the Doctor first told me of the case and told me of the location of the tumor under the peritoneum of the cul-de-sac, between the cervix and the rectum, I, of course, was reminded of those forms of adenomyoma which Dr. Curtis gave such a beatuiful description of some time ago and which Cullen also has described. Anatomically, the structure is very different. There are no glandular elements and no muscular elements. Before such adenomyomata of the rectovaginal septum, should undergo malignant degeneration and become carcinomatous, you still have to find glandular and muscular elements, none of which I have been able to see in these sections. It is very unfortunate that we did not get a post-mortem. It would have been extremely interesting to study the placental sac in this case and particularly to follow up the blood-vessels. It would have been extremely interesting to investigate the lungs.

DR. R. A. SCOTT: I would like to know if this tumor had started somewhere in the placenta, would section of it show anything abnormal in placental structure?

DR. RIES: In answer to Dr. Scott's question, the placenta in these cases may be absolutely normal. In one clinic of which I know they saved every placenta for years in the hope that some woman would develop a syncytioma afterward and they could study the placenta, but it did not work out. In all of the cases I know of in which the syncytioma developed afterward and where the placenta had been studied with the usual care, nothing abnormal had been found.

DR. VAN HOOSEN (closing): In answer to Dr. Heaney, the placenta showed no abnormality whatever. The patient had no trouble with the lungs; no cough. It was very difficult to secure bowel movements, possibly due to the pressure, but other than that she seemed to be normal except for pain, which was due undoubtedly to the pressure.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD APRIL 4, 1919, DR. THOMAS J. SULLIVAN PRESIDING

TRANSPLANTING OF BONE IN FRACTURE OF THE NECK OF THE FEMUR

DR. CHARLES DAVISON read a paper entitled "Transplanting Bone in Fracture of the Neck of the Femur," see p. 142.

DISCUSSION

DR. WILLIAM HESSERT: I did not quite understand whether Dr. Davison removes the graft or not. In the second place, I would like to ask him how he reconciles the action of this case according to Wolf's law. If the case goes three years without function, why was not the graft absorbed? When a bone is not functioning, it is said the graft is absorbed.

DR. WILLIAM R. CUBBINS: I would like to ask Dr. Davison how he places the graft? Does he drill into the cancellous structure of the head or simply drive the bone in?

DR. EMIL G. BECK: Would it not be possible to use the the head of the fibula from another person, who has just been killed, or one who has just died? The ingenious method of using a smooth surface of the joint and placing it in the cavity, might be developed to a greater extent. In a few years almost a normal head may be developed out of a small head of the fibula. We have seen regeneration of bone when narrow grafts of bone are placed in a bone cavity and in time it grows almost to the normal size of the tibia.

DR. DAVISON (closing): In answer to Dr. Hessert, the capital fragment was taken out in the third case, because it was a sequestrum.

Again answering thim, the reason why the upper part of the transplant did not atrophy, according to Wolf's law, in the third case, was that I began passive motion just the moment that I took the patient out of immobilization, and she had vigorous passive movements until she was on her feet.

The transplant was taken from the fibula on the same side. A good deal of investigation has been made by the French surgeons, Gangolphe and Bertein, on the effect of the removal of a segment of fibula for transplantation, on the walking strength of the leg. They concluded that it produced little or no harm regardless of the amount of regeneration. I have taken my transplants from the fibula of the same extremity, so that if I did any injury it would be only to the crippled extremity.

In the first and second types of cases I obtain the transplant from the lower superficial part of the fibula beginning two and a half inches above the ankle-joint, which leaves sufficient bone to retain the mortise of the ankle-joint.

Some one asked the age of the second patient. He was thirty-five years of age when operated upon.

About transplants from the cadaver, those who have studied the effects experimentally of bone grafting have learned that bone transplants graft with the greatest activity when taken from the same individual, next best, when taken from the next of kin and with diminishing activity as the distance from common origin increases. The transplant, to graft well, must be transferred immediately while it contains the blood and serum of the location from which it came, then if it is placed in the bone of the same individual; the reaction of the blood and serum of that individual is the same to it, as it was in its original location; whereas if the bone is taken from another individual that reaction is different. Cadaver transplants and heterogeneous transplants graft poorly.

In the first case, that of recent fracture, the transplant was put in to act as a local splint, a body which was sterile and not offending to the tissues of the recipient. It grafted the parts together and kept the capital fragment alive until circulation was re-established. The capital fragment and the shaft of the femur were stablized, they were grafted together, and the circulation throughout was maintained. There was no change in the capital fragment in the first case any more than there would be in the smaller fragment if the shaft of any other long bone was fractured and then united in good position.

In the second case the transplant was put in with the idea that it would produce a new capital fragment. The old devitalized capital fragment was left in place for a framework for the new bone cells to grow into, with the expectation that the old structure of the capital fragment would be entirely absorbed, that the transplant, which is really not the kind of bone that belongs in the location where it is placed, would be eventually absorbed. It is a foreign kind of bone to that locality and absorption begins as soon as its function is gone. It takes some time under the most favorable circumstances to absorb, a period of several years. In a yearling ram the process is completed in one year.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

THE casual reader of surgical texts no doubt is convinced that there is no necessity for another treatise on surgical treatment. Our book shelves are already groaning under the stress of large heavy volumes in operative treatment. The student of surgery, invariably is disappointed when he seeks counsel with his texts on treatment because so much is left to his discretion. Surgery of today is an art, the success of which depends on many factors and one of the greatest is that of observation to minute detail. The care to detail is what makes a great surgeon. The general principles of surgery are known to every surgeon, but the ways and means to accomplish an end are often obscure. A most delicate and technical operation may be performed with great skill and yet the omission of a detail may provoke a failure.

It is with the greatest of pleasure that the reviewer has scanned the pages of Warbasse's new treatise[1], frankly at first as a skeptic. This treatise which consists of three volumes is not a work on operative surgery but as the title indicates "Surgical Treatment." As the author states in the preface, his object is "to place in the hands of the surgeon the means for rendering help in every surgical condition under all circumstances." He recognizes that the ideal form of treatment cannot be carried out at all times and that the experienced surgeon will undertake a course of treatment with success which would mean disaster if undertaken by the less proficient; nevertheless many times the less experienced man must render aid in the most hazardous risks and under the most trying circumstances. It is, to the mind of the reviewer, to the latter that this work is of the utmost assistance and value.

The author has classified his material exceedingly well, and there is little duplication or overlapping. Volume I is devoted to the treatment of the general surgical processes, such as wounds, infection, gangrene, tumors, and the like, also diseases of bones, joints, bursæ, and fractures. The surgery of the blood-vessels and lymphatics is also considered in this volume. Volume II considers the head, spine, neck, thorax, breast, abdomen; and Volume III, hernia, rectum, anus, appendix, liver, gall-passages, genito-urinary system, pelvis, amputations, the extremities, plastic and cosmetic surgery, electricity and radiation, injuries from electric currents, gas poisoning, first aid, and the like. In all this work there are certain elements which are outstanding.

[1]SURGICAL TREATMENT; A PRACTICAL TREATISE ON THE THERAPY OF SURGICAL DISEASES FOR THE USE OF PRACTITIONERS AND STUDENTS OF SURGERY. By James Peter Warbasse, M.D. In 3 volumes. Philadelphia and London: W. B. Saunders Company, 1918.

In the discussion of treatment of regional surgery, the topic is introduced by a consideration of the surgical anatomy. The reader's mind is first refreshed regarding the anatomy and anatomical relations, and embryology when indicated. This is illustrated by many clear and instructive cuts. An ideal concise course of treatment is outlined in detail. In many instances this is not operative. When an operation is indicated, the ideal operation in the mind of the author is given and the postoperative treatment discussed. Nothing is omitted or left to the imagination of the reader. Formulas are given in detail. Possible complications are discussed with prognosis. If the ideal treatment cannot be carried out for various reasons, the possibilities are given. The technique of the various operations are exceedingly well illustrated. The various standard operations are given in detail, as well as the more unusual procedures. The author refrains from using proper name nomenclature although recognizing priority when well established. It is not the description of the operative technique which is the meat of this treatise although this is brilliantly done. The true value lies in the minute discussion of every surgical condition, as to the nature of the process and how it should be treated. The patient's welfare is always the first consideration. One is forced to reason as the author does and see the line of treatment.

The work is certainly a departure from the stereotype text on operative surgery. It stands alone in that it has a human element which embues the reader with a determination to help his patient to recover and not necessarily to perform an operation.

After reading this treatise there is no surgeon, be he experienced or not, but will be a more painstaking and courageous student, a better surgeon, and a greater benefactor to humanity.

ALTHOUGH the profession is still in the dark regarding the active cause of carcinoma, yet the enormous amount of work that has been done on malignant disease has brought its reward. The pathologist has done much to teach the surgeon the early signs and characteristics of cancer, as well as its manner of dissemination, so that today early and rational removal with the knife offers a modest reward for the sufferer. The subject of carcinoma as well as that of all neoplastic growths has a peculiar fascination. The mysterious onset, the insiduous and at times ravenous course of this atypical proliferation of cells, never ceases to cause the surgeon to wonder and resolve to know more regarding cell life

and cell proliferation. The complete assembly of facts regarding neoplastic diseases as it stands today is most ably set forth in Ewing's[1] new textbook on tumors.

It is amazing to see what he has done not only in America but abroad on the subject of tumors. Every possible clue has been studied with the hope of determining some possible factor which may lead to a definite etiology. A large amount of this work is given in detail with not only the author's version, but that of every other authority.

The text is divided into two parts; first a general discussion of tumor formation and especially carcinoma, is given. Then a classic description of the different tumors and a description of regional neoplastic diseases. The information seems final for today.

In no other work known to the reader is there such a fund of information regarding tumors. Every possible angle is discussed, even to symptoms and general lines of treatment.

Carcinoma is discussed from the standpoint of general characteristics, its malignancy, detailing much experimental work that has been done, then as a tumor with a description of the different types, and finally carcinoma as it may affect different organs and regions with its possible cause, types, course of growth with dissemination, symptoms, and at times treatment.

This work is without doubt the most classic and comprehensive discussion of the subject of neoplastic disease before the profession today and will be for some time.

VERY little has been written on the subject of birth fractures, probably because of the infrequency of the condition. Any one who has had any experience with the treatment of fractures of the femur, humerus and clavicle of a newborn infant realizes that he has a difficult task to perform. The recent atlas prepared by Truesdell[2], is most interesting. He devotes most of the volume to fractures of the skull, femur, clavicle, and humerus, with epiphyseal separations.

It is well illustrated with X-ray reproductions. The most interesting part is that relative to fracture of the humerus, epiphyseal separation, and a number of untreated as well as treated cases are shown with X-ray findings from time to time, illustrating the unusual and almost unbelievable processes of repair which not only cause union but soon almost completely efface the deformity.

The atlas is brief in text but extensively illustrated by roentgen illustrations which are most useful, not only in diagnosis but in demonstrating the changes which occur from time to time in bone union, the correction or development which occurs in fractures of the newborn.

[1] NEOPLASTIC DISEASES, A TEXTBOOK OF TUMORS. By James Ewing, A.M., M.D., Sc.D., Philadelphia and London: W. B. Saunders Company, 1919.

[2] BIRTH FRACTURES AND EPIPHYSEAL DISLOCATIONS. By Edward D. Truesdell, M.D. New York: Paul B. Hoeber, 1917.

THE surgical aspect of gunshot wounds of the abdomen has been considered since the advent of modern explosives. Many times have opinions been changed after apparent definite conclusions have been reached. The recent great war has proved certain definite facts, all of which are clearly stated in the little volume by Wallace.[3] The British during the Boer War had laid down definite procedures in regard to abdominal gunshot wounds. These were radically changed even after the beginning of hostilities in 1914.

In this volume the author classifies gunshot wounds of the abdomen into a working basis, giving anatomical considerations, the type of missile and surgical necessities. His deductions are based on sound surgical principles and ring true to conditions as they are met in active warfare. In the preface the author states: "This book contains the experiences in abdominal surgery of a sector of the battle line over a period of thirty months. It is founded on the practice of many surgeons, working under different conditions and in different hospitals. The personal equation and influence of locality have thus been largely eliminated. It is hoped, therefore, that the figures quoted may present a standard with which other surgeons can compare their results.

The authors tabulate a total of 965 cases, giving an anatomical classification with symptoms, pathology, and treatment of each. Many conditions relative to gunshot wounds are considered, such as distance, type of missile, condition of man when injured, type of warfare indulged in at the time, length of time injured, and means of surgical interference. Truly the little volume contains a mine of profitable information and data which are indeed interesting and instructive, and many of the principles can be applied to similar conditions in civil life.

A TYPE of wound which is prone to heal and leave a man disabled may, when given proper attention from the beginning, leave but little deleterious after-effect. This we see every day in civil life, and such findings were increased a thousand fold in the recent war. Not only the high mortality rate in the first years of the recent war but the thousand and tens of thousands of permanently crippled men bear evidence of this as compared with results during the latter part of the war. Not until definite ideas were formulated and equipment procured could proper treatment be put into action. Mayer,[4] in his monograph on orthopedic treatment of gunshot injuries, after a ripe and extensive experience abroad, places before the profession a goodly portion of the valuable information. He classifies the contents into treatment at the front and at the base hospital. Many injuries, if not

[3] WAR SURGERY OF THE ABDOMEN. By Cuthbert Wallace, C.M.G., F.R.C.S. (Eng.), M.B., B.S. (Lond.) Philadelphia: P. Blakiston's Son & Co.

[4] THE ORTHOPEDIC TREATMENT OF GUNSHOT INJURIES. By Leo Mayer, A.M., M.D., with an introduction by Col. E. G. Brackett, M.C., U.S.A., Philadelphia and London: W. B. Saunders Company 1918.

properly treated at the front, never reach the base hospital, and if they do are doomed to long and tedious convalescence with disability which should not exist.

The author in brief describes the immediate treatment of wounds, that the least deformity may be expected. Under this division he describes the early treatment of fractures. The larger part of the work is devoted to the treatment of deformities produced by trauma, and many if not all of the principles laid down can be applied to similar injuries sustained in civil life. The information is especially valuable because it has a close bearing on industrial surgery of today.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

SYMPTOMS OF VISCERAL DISEASE; A STUDY OF THE VEGETATIVE NERVOUS SYSTEM IN ITS RELATIONSHIP TO CLINICAL MEDICINE. By Francis Marion Pottenger, A.M., M.D., LL.D., F.A.C.P. St. Louis: C. V. Mosby Company, 1919.

GERIATRICS; A TREATISE ON SENILE CONDITIONS, DISEASES OF ADVANCED LIFE AND CARE OF THE AGED. By Malford W. Thewlis, M.D. St. Louis: C. V. Mosby Company, 1919.

THE PERITONEUM. VOL. I—STRUCTURE AND FUNCTION IN RELATION TO THE PRINCIPLES OF ABDOMINAL SURGERY; VOL. II—DISEASES AND THEIR TREATMENT. By Arthur E. Hertzler, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1919.

LE TUBE COOLIDGE SES APPLICATIONS SCIENTIFIQUES MEDICALES ET INDUSTRIELLES. By H. Pilon. Paris: Masson et Cie, 1919.

ESSENTIALS OF SURGERY; A TEXTBOOK OF SURGERY FOR STUDENT AND GRADUATE NURSES AND FOR THOSE INTERESTED IN THE CARE OF THE SICK. By Archibald Leete McDonald, M.D. Philadelphia and London: J. B. Lippincott Company, 1919.

LA PROTHESE FONCTIONNELLE DES BLESSES DE GUERRE, TROUBLES PHYSIOLOGIQUES ET APPAREILLAGE. By Dr. Ducroquet. Paris: Masson et Cie, 1919.

A STEREOSCOPIC ATLAS OF PLASTIC SURGERY OF THE FACE, HEAD AND NECK, WITH CASE REPORTS. By Joseph C. Beck, M.D., F.A.C.S., and Ira Frank, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1919.

THE REDEMPTION OF THE DISABLED; A STUDY OF PROGRAMMES OF REHABILITATION FOR THE DISABLED OF WAR AND OF INDUSTRY. By Garrard Harris. Introductory chapter by Frank Billings, M.D. New York and London: D. Appleton & Co., 1919.

THE OXFORD MEDICINE. Advance pages. Vol. 1, part 2. Edited by Henry A. Christian and Sir James Mackenzie. New York: Oxford University Press, 1919.

A TREATISE ON ORTHOPÆDIC SURGERY. By Royal Whitman, M.D., M.R.C.S. (Eng.), F.A.C.S. 6th ed. thoroughly revised. Philadelphia and New York: Lea & Febiger, 1919.

COLLOIDS IN BIOLOGY AND MEDICINE. By Prof. H. Bechhold. Authorized translation from the second German edition, with notes and emendations. By Jesse G. M. Bullowa, A.B., M.D. New York: D. Van Nostrand Company, 1919.

THE AFTER-TREATMENT OF WOUNDS AND INJURIES. By R. C. Elmslie, M.S., F.R.C.S. Philadelphia: P. Blakiston's Son & Co., 1919.

MILITARY SURGERY OF THE EAR, NOSE AND THROAT. By Hanau W. Loeb, M.D., Major, Medical Reserve Corps, U. S. A. Medical War Manual No. 8. Authorized by the Secretary of War and under the Supervision of the Surgeon General and the Council of National Defense. Philadelphia and New York: Lea & Febiger, 1919.

THE OPERATIONS OF OBSTETRICS EMBRACING THE SURGICAL PROCEDURES AND MANAGEMENT OF THE MORE SERIOUS COMPLICATIONS. By Frederick Elmer Leavitt, M.D. St. Louis: C. V. Mosby Company, 1919.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION. VOL. XXXVI. Edited by John F. Binnie, M.D. Philadelphia: Wm. J. Dornan, 1918.

UM NOVO TRATAMENTO DA BLENNORRHAGIA DO HOMEN. By Dr. Annibal Pereira. Rio de Janeiro: A. J De Castilho, Editor, 1919.

AN OUTLINE OF GENITO-URINARY SURGERY. By George Gilbert Smith, M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1919.

SQUIBB'S MATERIA MEDICA, 1919 Edition. New York: E. R. Squibb & Sons.

GYNOPLASTIC TECHNOLOGY; WITH A CHAPTER ON SACRAL ANESTHESIA. By Arnold Sturmdorf, M.D. Philadelphia: F. A. Davis Company, 1919.

BULLETIN NO. 11. PHYSICAL EXAMINATION OF THE FIRST MILLION DRAFT RECRUITS; METHODS AND RESULTS. Compiled under the direction of the Surgeon General, 1919.

THE STUDENT'S TEXTBOOK OF SURGERY. By H. Norman Barnett, F.R.C.S. St. Louis: C. V. Mosby Company, 1919.